

# Casing Frozen Strawberries

automatic carton-casing and case sealing equipment effects substantial savings in fruit and vegetable freezing plants

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**Recent studies**—in 17 California fruit and vegetable freezing plants—indicate that mechanization of the casing operation could effect substantial savings in many of the plants.

Although—in this report—application of the data obtained through the studies is to plants packing strawberries in cases containing 24, 10-ounce, cartons similar results could be obtained with containers of other sizes.

The three casing methods—manual, semi-mechanical, mechanical—in general use in the plants studied were analyzed in relation to the amount of labor and equipment required.

The manual method—Method A—has four components: 1, stencil, form, and staple case; 2, fill case; 3, seal case; and 4, setoff. Workers on a raised platform or mezzanine take bundles of flat fiberboard cases from nearby temporary storage, place them on a table, remove the twine binding, stencil each case, and then move it to a case-forming table. The cases are formed manually by a worker as he transfers them individually from the table to a power stapler. The bottom of the case is stapled and the case placed in

a chute leading to the casing area. Another worker transfers the case to a filling station, takes cartons—four at a time—from the carton conveyor and puts them in the case. The filled case is pushed aside to the case-sealing and palletizing station where a setoff worker receives the case. He seals the case by applying glue to the flaps—usually with a 3"–4" brush—and sets the case aside to a pallet for transfer to the freezer. Pallets are stacked with layer dividers—generally six 1" × 4" to 3" × 4" slats—placed between every second layer to allow air circulation.

The semi-mechanical method—Method B—eliminates the labor involved in stapling and sealing by using a non-stapled case and automatic sealing equipment. In this method, the four components are: 1, stencil and form case; 2, fill case; 3, mechanically seal case; and 4, setoff. Cases are stenciled as in method A but case formers work near the casing station. Cases are formed by opening the flat case, folding the bottom flaps in, and inverting the case to flatten the bottom flaps and prepare it for manual filling. The formed case is set aside to the casing conveyor or—if cases accumulate tem-

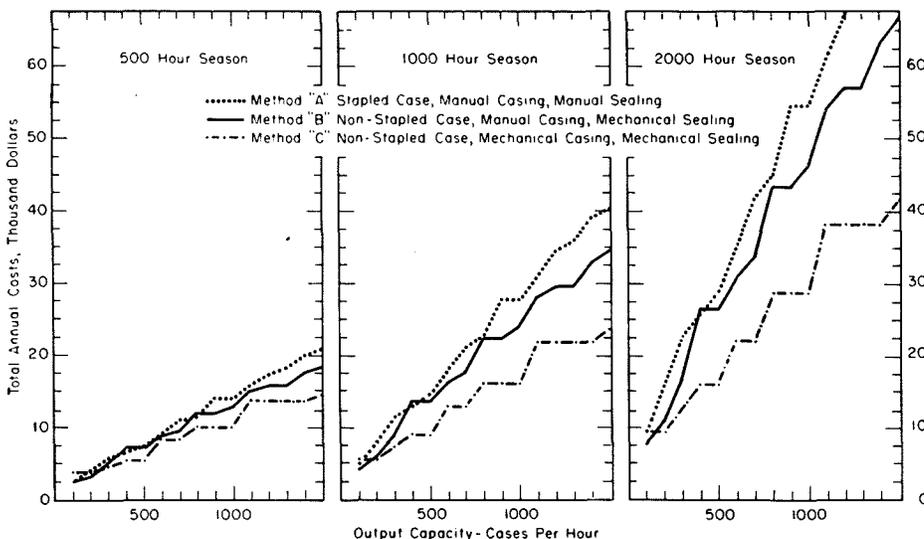
porarily—to a stack of cases adjacent to the conveyor. The fill-case worker takes the case and fills it as in the manual method. The case then passes through an automatic sealer and compressor to the palletizing area where a setoff worker sets it aside to a pallet.

In the most mechanized method observed—Method C—the cartons are conveyed directly from the seamer into a casing machine where they are mechanically filled. Again, there are four components: 1, stencil case; 2, form case and operate casing machine; 3, mechanically seal; and 4, setoff. The stencil and setoff components are the same as in the semi-mechanized method. The casing machine and its operator—who forms the case—replace both the case forming and case filling workers. In this method the flat case is opened, the bottom flaps folded down, and the case placed over a sleeve on the casing machine. When the product is frozen before casing—as in plate or cabinet freezers—an additional worker must guide the cartons into the machine.

Work standards were developed—from time and production studies—for every job performed, to establish labor requirements for each of the three methods. These standards represent the production a reasonably efficient worker could attain. They were found by converting the actual work time per case,

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**Total annual costs of casing strawberry cartons in California freezing plants.**  
(For 24, 10-ounce, cartons shown in relation to method used, casing capacity, and length of season.)



**Total annual cost**—as shown in the 500-hour season graph at the left—for manual casing is \$14,000, Method B, \$12,500, and of Method C, \$10,000. In the 2,000-hour season graph on the right the total annual cost at a capacity output rate of 1,000 cases per hour of Method A is shown to be \$54,700, of Method B, \$46,400, and of Method C, \$28,500.

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# CASING

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plus an allowance for unavoidable delay—such as scheduled rest periods, personal time, uneven flow of product—to cases per hour. In this report, the standard for every job considered falls between the average and the highest output rate achieved in the plants studied.

**Work Standards for Casing Jobs in Fruit and Vegetable Freezing Plants**

Job	Method	Standard cases/man hour
Stencil	A <sup>1</sup> , B <sup>2</sup> , C <sup>3</sup>	765
Form case	A	275
	B	335
	C	500
Fill case	A	170
	B	195
Setoff	A	205
	B, C	365

A<sup>1</sup>—Manual, stapled case.  
B<sup>2</sup>—Semi-mechanical, nonstapled case.  
C<sup>3</sup>—Mechanized, nonstapled case.

The case-forming standard of the semi-mechanical method—Method B—is larger than for the manual method because the stapling component of the job has been eliminated. It is still larger for the mechanized method—Method C—because the work involved in inverting the formed case and flattening the bottom flaps for manual filling is unnecessary.

The fill-case standard of the semi-mechanical method is larger than the manual method because less time is required to obtain cases from the conveyor than from a chute.

The setoff standard of the manual method is low in comparison with the other two methods because it includes the job of case sealing as well as setoff.

The only equipment items common to all three methods—at all output rates—are the stencil table and stencil wheel. One each is required at rates up to 765 cases per hour and a second set is required for greater output.

The major item of equipment for manual casing is the case stapler and the number required is set by the work standard of the operator. One stapler is needed for output rates to 275 cases per hour and another stapler for each additional multiple or fraction of that number. Also, there must be a case-forming table for use with each stapler. Other equipment needed depends on the speeds of carton fillers used, but averages one glue stand and 15' each of case chute and skate conveyor for each multiple of 250 cases per hour of capacity output rate.

Over 95% of the equipment replacement cost for semi-mechanical casing is accounted for by the case sealer, with one sealer required for every 500 cases per hour of output capacity. Other equipment used with each sealer consists of a case-forming table and 10' each of skate conveyor and steel roller conveyor.

The equipment replacement costs of the mechanized method of casing are almost entirely—over 98% at all output rates—for the casing machine and case sealer. A caser, sealer, case-forming table, and 10' of steel roller conveyor are required for output rates to 500 cases per hour and for each multiple or portion greater than 500.

Crew requirements and labor costs—based on the work standards—for outputs from 100 to 1,500 cases per hour were calculated for each of the three methods. Charges of 2.5¢ per hour per motor horsepower for electric power and 0.5% of replacement cost of equipment per 100 hours use for variable equipment repairs and maintenance were added to the labor costs to obtain total variable cost per hour.

Replacement cost of equipment was estimated at current prices. An annual fixed charge of 16.5% of equipment replacement cost was made to cover depreciation, interest on investment, taxes, insurance, and fixed repair and maintenance.

Total annual costs—in relation to output per hour and length of season—were found by multiplying the hourly variable

costs by the hours operated per season and adding the annual fixed charge. These costs are plotted on page 2.

All methods are nearly equal in total seasonal cost at low rates of output for short seasons. However, the semi-mechanical method becomes superior to the manual method at higher rates of output and longer seasons.

Some savings in total seasonal cost through use of the mechanized method appear possible even in comparatively short seasons—of 500 operating hours if output rate is high—because the casing equipment has high fixed capacity and becomes most efficiently used at high rates of output. As a large portion of the costs are fixed costs the greatest advantage appears when operating hours per season increase.

The indicated savings as represented in the graphs apply to the specified operating methods, labor and equipment output standards, and cost rates specified in this article and some adjustment may be necessary for application to particular situations. The analysis—for example—is based on the room-freeze process with the product cased before freezing. If plate or cabinet freezers are used and

**Costs of Casing 24, 10-oz., Strawberry Cartons in California Freezing Plants, 1956**

Capacity output (cases/hour)	Workers required		Power, variable repairs, maintenance cost/hour <sup>3</sup>	Total variable costs/hour <sup>4</sup>	Replacement cost of equipment <sup>5</sup>	Annual fixed charge <sup>6</sup>
	Stencil, form, and fill case <sup>1</sup>	Setoff <sup>2</sup>				
<b>Manual—Method A</b>						
100	2	1	\$0.04	\$ 4.82	\$ 720.00	\$ 119.00
200	4	1	0.04	7.90	720.00	119.00
300	5	2	0.09	11.19	1,380.00	228.00
400	6	2	0.09	12.73	1,380.00	228.00
500	6	3	0.09	14.43	1,380.00	228.00
1,000	12	5	0.17	27.15	2,760.00	455.00
1,500	17	8	0.25	40.03	4,080.00	673.00
<b>Semi-mechanical—Method B</b>						
100	1	1	\$0.23	\$ 3.47	\$ 4,165.00	\$ 687.00
200	2	1	0.23	5.01	4,165.00	687.00
300	4	1	0.23	8.09	4,165.00	687.00
400	6	2	0.23	12.87	4,165.00	687.00
500	6	2	0.23	12.87	4,165.00	687.00
1,000	11	3	0.47	22.51	8,380.00	1,383.00
1,500	15	5	0.70	32.30	12,510.00	2,064.00
<b>Mechanized—Method C</b>						
100	1	1	\$0.59	\$ 3.83	\$11,150.00	\$1,840.00
200	1	1	0.59	3.83	11,150.00	1,840.00
300	2	1	0.59	5.37	11,150.00	1,840.00
400	2	2	0.59	7.07	11,150.00	1,840.00
500	2	2	0.59	7.07	11,150.00	1,840.00
1,000	4	3	1.18	12.44	22,300.00	3,680.00
1,500	5	5	1.77	17.97	33,390.00	5,509.00

<sup>1</sup> Hourly wage rate—\$1.54.

<sup>2</sup> Hourly wage rate—\$1.70.

<sup>3</sup> Power calculated at 2.5¢ per hour per motor horsepower. Variable repairs and maintenance calculated at 0.5% of replacement cost per 100 operating hours.

<sup>4</sup> Includes labor, power, and variable repairs.

<sup>5</sup> Replacement prices used in calculations:

Method A—stapler, \$475; glue stand, \$25; case chute, \$5 per foot; and skate conveyor, \$4 per foot.

Method B—sealer and compressor unit, \$4,000; skate conveyor, \$4 per foot; and steel roller conveyor, \$6.50 per foot.

Method C—casing machine, \$7,000; sealer and compressor unit, \$4,000; and steel roller conveyor, \$6.50 per foot.

All methods—stenciling and case forming tables, \$25; and stencil wheels, \$35.

<sup>6</sup> Calculated as a percentage of replacement cost. Includes depreciation, 10%; fixed repairs, 1.5%; taxes, 1%; insurance, 1%; and interest, 3% (approximately 5.5% on undepreciated balance). Total of 16.5%.

the product is cased after freezing, costs are slightly higher with all methods. With the manual and the semi-mechanical methods the higher cost is caused by a reduction in the production standard for the casing workers to approximately 155 cases per hour. This increases estimated variable costs about 2% with the manual method and 8% with the semi-mechanical method. With the mechanized method an additional worker is required to guide the cartons from the freezing trays into the casing machine. This would increase estimated labor costs by \$1.70 per hour per machine. Changes in the analysis—necessitated by these cost differences—

could be approximated by corrections in the larger table on the preceding page. Such correction would show a moderately decreased cost advantage of the semi-mechanical method over the manual and of the mechanized method over both, with the amount of change depending on rate of output and number of hours operated.

To estimate potential savings to be effected by the mechanization of the casing operation in some plants—or producing areas—adjustments in production standards, wage rates, equipment replacement and depreciation, and other charges might be appropriate. Questions of plant

flexibility and availability of qualified equipment maintenance personnel in small plants, as well as variation in charges for labor and equipment, might well enter the calculations but with suitable adjustment of the basic data, computations could be made for such cases.

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*This is the second in a series of progress reports on efficiency in the processing and marketing of frozen fruits and vegetables. The studies are being conducted cooperatively with the State Experiment Stations in Washington, Oregon, and Hawaii and the Agricultural Marketing Service, U.S.D.A.*

## WEEDS

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were drained beginning June 15 when the rice was 7"-8" high. The fields drained rapidly and it was possible to get into the fields with ground equipment by June 23.

The spray equipment was mounted on a track-type tractor with special extensions attached to the tracks. The extensions were needed only in a few exceptionally wet spots in the field. A volume of 28 gallons per acre was applied at 20 pounds pressure through a broadjet nozzle covering a 40' swath.

All spraying was done at night—to take advantage of still air conditions and minimize the possibility of drift from air movement—with 220 acres sprayed in three nights. Because of concern over mounting daytime air temperatures, 100 acres were left unsprayed. Previous experimental work and field experience had shown increased susceptibility of the rice plant to injury when daytime temperatures reached 95°F and higher. During the period of spraying—June 23, 24 and 25—maximum day temperatures ranged from 95°F-100°F. On June 26 the maximum reached 101°F. It rose to 105°F on June 27 and 108°F on June 28, falling thereafter.

The MCPA was applied to part of the field at 10 ounces of actual MCPA per acre. Due to error in mixing, another part of the field received only 4¾ ounces of actual MCPA. Weed control was good even at the lower rate but was better at the 10-ounce rate. Skips and unsprayed areas were a mass of weeds with rice plants barely discernible. The most abundant weed was umbrella sedge with water plantain and burhead present in quantity.

Flooding was begun soon after the spraying and it took an average of six days to reflood the various fields. The entire operation from draining to flooding covered 19 days.

The average yield on the 220 acres

sprayed was 4,450 pounds of dried paddy rice per acre. The unsprayed field yielded 2,200 pounds per acre. The rice lodged in the unsprayed field when the water was taken off before harvest because the heavy growth of umbrella sedge pulled the rice down as it settled. The sprayed rice did not lodge.

All investigative work to date indicates that 55-65 days after planting is the safest period to spray. However, the two instances of plane and ground rig application indicate the possibility of early spraying on drained rice with MCPA at low rates. MCPA is more selective than 2,4-D and that increased selectivity is especially important if spraying is done early or when temperatures are high.

Early spraying should be considered as a last resort where weed competition is extremely severe.

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## RICE YIELDS

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rice to eliminate the milled rice variable which would exist if pounds head were used. An approximate pounds head value can be obtained by multiplying the per cent by an appropriate total rice value—for example—80% times 70 pounds total milled rice gives 56 pounds head rice.

The yield of total milled rice in the humidified drying-air study was reduced significantly by an increase in drying temperature or a lowering in drying humidity. The reduction rate was nearly constant as drying progressed.

Humidification of the drying-air improves the quality of the dried rice remarkably. One-pass drying at 110°F and about 33% relative humidity produced

the same head yield as three-pass drying at 110°F with unhumidified air. Higher humidities produced even higher head yields.

Humidification caused an extension of the drying time. The three-pass drying required 2.2 hours. One-pass humidified drying required 4.5 hours to yield the same quality product.

Checking of the rice increases at a faster rate as drying progresses at any given humidity. During the removal of the first 4% of moisture—at 130°F—12% checked while 45% checked during the last 4% of moisture removed.

The results of these studies indicate the possibility of increasing both yield and quality of column-dried rice by using elevated humidity drying air. However, because this process extends the drying time considerably, a procedure would be required that would yield satisfactory capacity such as stage single-pass drying—using high-temperature low-relative-humidity air to remove the first few per cent of moisture, finishing with lower-temperature higher-relative-humidity air—reducing the number of passes by humidifying during one or more passes or additional drying capacity to use complete low-temperature high-relative-humidity drying.

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## FERTILIZER

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ing an ammonium source of nitrogen and providing for its maintenance in flooded soils for rice was shown to be an important factor in achieving the best utilization of nitrogen for the best growth and yields of rice.

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