

Frozen Strawberries

study indicates efficiency of mechanical crate dumping in most processing plants

Carleton C. Dennis and Robert H. Reed

Time and production studies of two different methods of dumping strawberry crates—manual and mechanical—were made in several California frozen food processing plants during the 1956 season.

Data obtained in the studies indicated that substantial savings could be effected in many plants by installation of a mechanical crate dumping system. In large plants operating a long season, the savings could exceed \$7,500 annually.

With either manual or mechanical dumping, pallets containing approximately 70 full crates are taken from the unloading area by fork-lift truck to the dumping station and empty crates go by conveyor through a washer to a stacking area.

Where the manual dumping method is used, the crate-dump worker takes a crate from the pallet, turns, places the crate against a bar on the dump hopper, slowly inverts the crate over the hopper and completes the dump by tapping the crate on the hopper bar before putting it on the empty-crate conveyor.

In a plant with mechanized dumping, a set-on man transfers the crates singly from the pallet to a conveyor leading to the dumper. The crate passes through the dumper and onto the crate-washer conveyor. The berries are dumped onto a wide conveyor belt and carried to the

shaker-washers. Shear gates divert the berries from the belt and divide them among the inspection lines as desired. The actual dump layout as considered in this study was not found in its entirety in any one plant, but all the equipment and methods were observed in use.

The actual rate of manual dumping varied in the plants studied from 190 to 400 crates per hour. However, within the capacity of the dumper, the rate is governed by the flow of fruit required by the sorting table. The dump worker adjusts his pace to that rate, to maintain the proper flow of fruit. The studies indicated that a rate higher than the maximum observed—probably as high as 650 crates per man-hour—could be maintained by an average worker. However, grading-line capacities in most of the plants approximated 5,000 pounds of berries—about 355 crates—per hour and, with one worker per line, that was the practical operating rate for the manual dumping job as presently organized.

The machine-dump method eliminates manual emptying and placing of crates on the conveyor, and a higher capacity rate of approximately 1,200 crates per man-hour is estimated for the remaining set-on operation. However, to maintain a 1,200-crate rate most workers would need relief shifts to easier jobs.

The machine dump is a high volume method capable of serving several lines. Therefore, it is likely to become more economical as plant capacity increases.

To show the effect of plant capacity on cost, the table on this page gives crew and equipment requirements and costs for six different sizes of plant. The index of plant size in the table is the number of inspection lines of 5,000 pounds per hour capacity. Such an index provides a practical basis for comparison, because inspection belt design and capacities were highly standardized among the different plants studied.

Where the manual dumping method is used, one worker per line is required. Variable costs per hour—as shown for the one-line plant—are \$1.78 per hour including \$1.70 per hour for labor and \$0.08 for electric power and equipment repair. Investment for the dumping equipment—one shaker-washer per line—is estimated at \$1,350 on the basis of replacement cost at current prices. Dumping costs with the manual method increase directly in proportion to an increase in the number of inspection belts.

With the mechanical dumping method, one worker is adequate for plants ranging from one to three lines in size. To supply four inspection lines, two dump workers are required, but to minimize equipment investment, it was assumed that a manual-dump method would be used for the fourth line. In five- and six-line plants, two workers and two machine-dumping units are provided. Variable costs for mechanical dumping are estimated as for manual dumping; equipment investment costs include charges for pallet conveyor, dumper, distributor conveyor, and shaker-washer. With both methods annual fixed charges for equipment are estimated by applying appropriate percentages to the estimated equipment replacement cost to allow for

Costs of Dumping Strawberries in California Freezing Plants, 1956

Number of inspection belts ^a	Number of dump workers required ^b	Variable costs/hour		Equipment	
		Power and equipment repairs ^c	Total (including labor) ^d	Total investment ^e	Annual fixed charge ^f
Manual Dump					
1	1	\$0.08	\$1.78	\$1,350.00	\$223.00
2	2	0.17	3.57	2,700.00	446.00
3	3	0.25	5.35	4,050.00	668.00
4	4	0.33	7.13	5,400.00	891.00
5	5	0.41	8.91	6,750.00	1,114.00
6	6	0.50	10.70	8,100.00	1,337.00
Mechanical Dump					
1	1	0.34	2.04	5,520.00	911.00
2	1	0.43	2.13	7,120.00	1,175.00
3	1	0.53	2.23	8,695.00	1,435.00
4	2	0.61	4.01	10,045.00	1,657.00
5	2	0.96	4.36	15,815.00	2,609.00
6	2	1.05	4.45	17,390.00	2,869.00

^a Inspection belt capacity—5,000 pounds/hour.

^b Dump worker wage—\$1.70/hour.

^c Power estimated at \$0.03 per motor horsepower hour; variable repairs estimated at 0.5% of replacement cost per 100 hours of use.

^d Includes labor and equipment, power and variable repairs.

^e Calculated on following basis: manual dump—one shaker-washer per inspection line at \$1,350 each; mechanical dump—one shaker-washer per inspection line at \$1,350 each; one dumper per mechanical dump station at \$2,450; one pallet conveyor per mechanical dump station at \$920; and distributor conveyor varying in price from \$750 for one inspection belt to \$2,450 for six inspection belts.

^f Calculated on replacement cost basis. Includes depreciation, 10%; fixed repairs, 1.5%; taxes, 1%; insurance, 1%; and interest, 3%. Total of 16.5%.

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depreciation, interest on investment, repair, insurance, and tax expense.

Total costs of operation per season may be calculated from the tabulated data as the sum of the variable costs per hour multiplied by the hours operated per season plus the annual fixed charge for equipment. The results of such calculations for plants operating 500, 1,000 and 2,000 hours per season are shown in the graphs on this page.

Comparison of the two dumping methods gives the annual savings—or loss—of a mechanical dump. Manual dumping is superior to mechanical dumping in plants employing only one inspection belt because the mechanized method requires additional equipment expense and has no compensating labor saving in this case. However, moderate savings are possible in plants with two inspection lines operating more than 500 hours annually, and substantial savings can be made in larger plants.

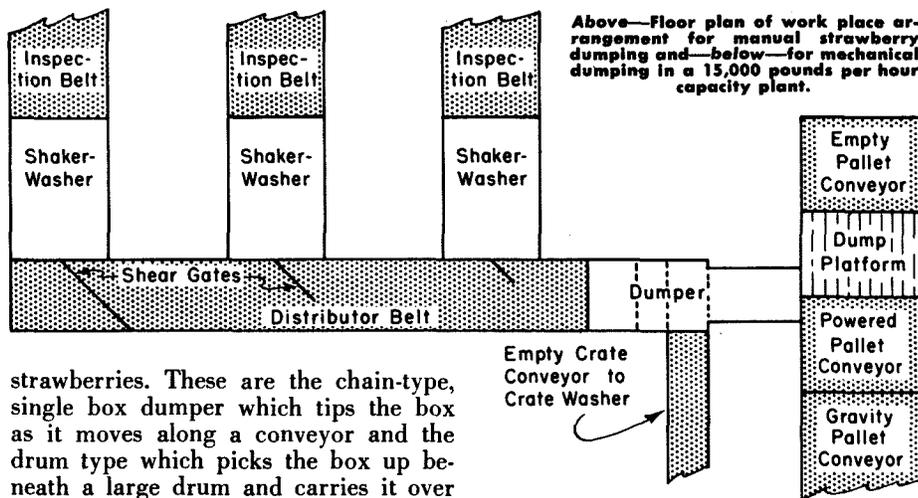
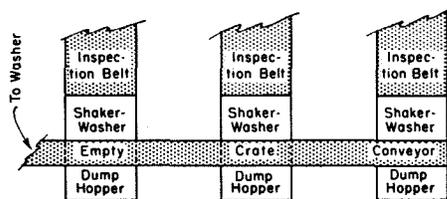
Potential savings increase as length of operating season increases. These savings can be realized in many California plants because they operate an average of about 1,000 hours annually. Some plants have operated nearly 3,000 hours in one season.

Costs were calculated on the basis of plant operation at capacity. However, the cost relationship is similar if plants operate their inspection lines at less than capacity. For instance, if a plant operates at between 10,000 and 15,000 pounds per hour, three lines are required and potential savings in dumping costs—through the use of mechanical dumping—are the same as a three-inspection-line plant operating at capacity. If a plant has idle lines a significant part of the time, the variable costs of either type of dump will decrease, but the mechanical dump

will appear less favorable because of a smaller decrease in variable cost while fixed cost remains the same. Less than capacity operation will increase the unit costs of crate dumping as well as total plant costs per unit of packout.

The mechanical crate dumper considered in this study is an adaptation of a box dumper developed primarily for prune packing. The dumper guides the crate off the end of a conveyor, dumps the berries, and deposits the empty crate on the crate-washer conveyor. There are at least two additional box dumpers which are used for other products and probably could be adapted to use for

—substituted for the individual washers used on each inspection line—then to flume the berries to individual dewatering belts leading to each inspection line. Both methods are nearly equal in equipment replacement cost to the mechanical dump and conveyor-belt distribution system. However, dumping to a large



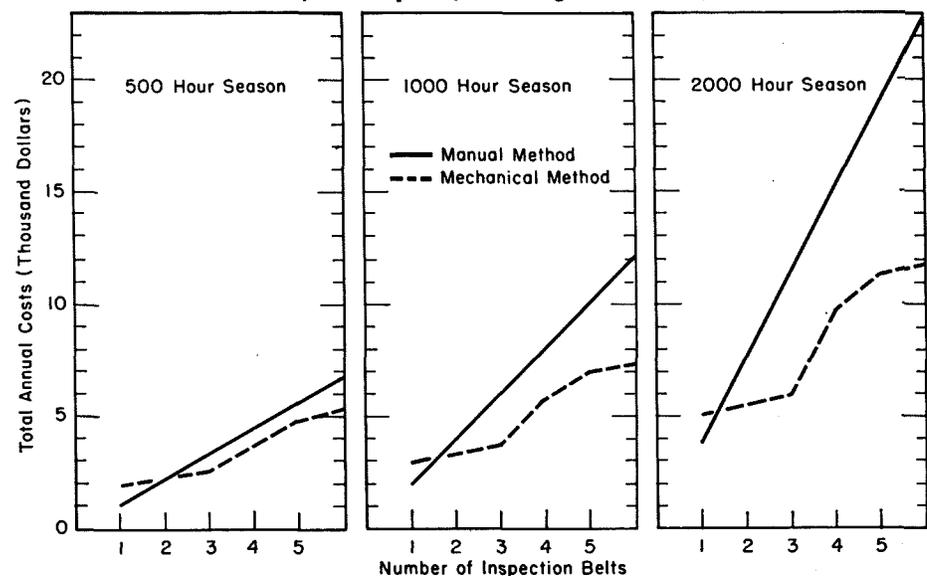
Above—Floor plan of work place arrangement for manual strawberry dumping and—below—for mechanical dumping in a 15,000 pounds per hour capacity plant.

strawberries. These are the chain-type, single box dumper which tips the box as it moves along a conveyor and the drum type which picks the box up beneath a large drum and carries it over the drum, inverting it and depositing the berries onto a belt.

Variations in distribution methods include substitution of a water bath for the wide conveyor belt as a receiver for the berries and fluming, rather than conveying, the berries to the shaker-washers. A second possibility is to dump the berries directly into a large shaker-washer

shaker-washer would be less practical when converting from manual to mechanical dumping because of probable loss in disposal of existing standard shaker-washers. If shaker-washers already installed in an existing plant are used in conjunction with either the conveyor-belt or water-bath mechanical dump, no substitutions for existing equipment are required, and the full savings potential shown in the chart would be realized. Manual dumping to a water bath and fluming to inspection belts is a method which could result in costs approximately midway between mechanized and manual dumping for plants operating at over 10,000 pounds per hour. Size grading before sorting is a technology which alters the plant equipment layout but has negligible effect on dumping costs.

Annual costs of dumping strawberries in California freezing plants in relation to methods used, size of plant, and length of season, 1956.



Carleton C. Dennis is Cooperative Agent of the University of California Agricultural Experiment Station and the Agricultural Marketing Service, U.S.D.A.

Robert H. Reed is Cooperative Agent of the University of California Agricultural Experiment Station and the Agricultural Marketing Service, U.S.D.A.

This is the first 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 Experiment Stations in Washington, Oregon and Hawaii and the U.S.D.A., A.M.S.