

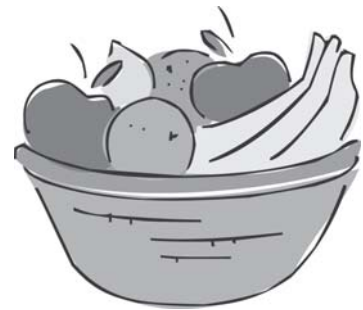
Water Efficiency

Industry Specific Processes



Fruit and Vegetable Processing

The fruit and vegetable processing industries may be described as consisting of two segments: fresh pack and processing.



The former collects crops and field packs them into lug boxes or bulk bins for shipment to a produce finishing plant. Products are cooled to preserve integrity and fumigated or treated to control insect infestation or microbial disease development. Products may be culled, graded or trimmed. Product is sold as fresh produce. The processing segment, or packers, includes all unit operations, extending the shelf life of food being processed and adding value through produce modification to satisfy market niches.

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The fresh pack segment of the industry shares unit operations with the processing segment. These operations are the sorting/trimming, washing, grading and packing lines. But after the packing lines, additional unit operations may add to the waste-generating scheme for the processing segment alone. Additional operations may include combinations of peeling, stemming, snipping, pitting, trimming, chopping and blanching. In some instances, the final product is dehydrated (e.g., chopped onions). In others, it is packaged and processed. Processing can include one treatment or a combination of several treatments (e.g., acidifying, brining, freezing, cooking or cooling).

Major water use and waste-generation points associated with the fruit and vegetable industry include the washing steps for raw and processed produce, peeling and pitting practices, blanching, fluming the produce after blanching, sorting and conveying the product within the plant and cooling after processing. Reducing size, coring, slicing, dicing, pureeing and juicing process steps, as well as filling and sanitizing activities after processing, also contribute to the waste stream.

Wastewater Characterization

Major wastewater characteristics to be considered for the vegetable and fruit processing industry are the wide ranges of wastewater volume and the concentrations of organic materials. Wastewater characteristics can be influenced by a number of factors such as the commodity processed, the process unit operations used, the daily-production performance level and the seasonal variation, e.g., growing condition and crop age at harvest. Figure 5-6 presents historical data collected from raw wastewater discharged from the vegetable- and fruit-processing industry.

Water Use and Wastewater Sources

In the processing environment for vegetable and fruit material handling, heating, cooling and packaging, there are six major contributing point sources for waste. These sources are

the following operations: (1) raw produce washing, grading and trimming, (2) washing after steam/lye peeling and/or size reducing, (3) blanching and fluming, (4) filling, (5) sanitation/plant cleanup, and (6) processed product cooling. Plant management practices greatly influence process operation efficiency relative to final product yield and waste quantity generated. (Refer to Figure 5-6 for industrial variability.)

Water Use and Waste Minimization

Ideally, considerable waste reduction can be achieved if harvesting equipment permits additional stems, leaves and culled materials to remain in the field during harvest. If crop washing, grading and trimming can occur in the field, then additional soil and food residues will remain at the farm. Realistically, most such wastes are being handled at vegetable and fruit processing plant sites. Primary waste-management strategies used by this industry are water conservation and waste-solids separation.

Water use by the vegetable and fruit processing industry is essential to the washing, heating and cooling of food products. But the industry has adopted a number of practices, showing increased sensitivity to the need for water conservation:

1. Use of air flotation units to remove suspended debris from raw crop materials.
2. Recovery and reuse of process water throughout the processing plant.
3. Decrease of water volume use in peeling and pitting operations, as well as decrease of raw product losses.
4. Separation of waste process streams at their sources, for potential byproduct use.
5. Countercurrent reuse of wash and flume/cooling waters.
6. Separation of low- and high-strength wastestreams.

7. Installation of low-volume, high-pressure cleanup systems.
8. Conversion from water to steam blanching.
9. Use of air cooling after blanching.

ing, trimming, peeling, pitting, cutting or slicing, inspecting and grading. Unwanted and undesirable materials must be removed before the fruits undergo additional processing, but not all fruits are subject to each step. For example, cherries and plums may be canned whole and unpeeled, whereas apples, peaches and pears must be peeled and either cored or pitted before being canned. Peeling can be by hand or with machines, chemicals or steam.

Fruit Processing (Canning, Freezing, Fermenting, etc.)

The initial preparation processes for canned, frozen and fermented fruits are washing, sort-

Figure 5-6

Representative Wastewater Loadings Per Ton of Product Associated with Typical Vegetable and Fruit Raw Products			
Crop	Flow (1,000 gal/ton) minimum	Flow (1,000 gal/ton) mean	Flow (1,000 gal/ton) maximum
Vegetable products			
Asparagus	1.9	8.5	29.0
Bean, snap	1.3	4.2	11.2
Broccoli	4.1	9.2	21.0
Carrot	1.2	3.3	7.1
Cauliflower	12.0	17.0	24.0
Pea	1.9	5.4	14.0
Pickle	1.4	3.5	11.0
Potato, sweet	0.4	2.2	9.7
Potato, white	1.9	3.6	6.6
Spinach	3.2	8.8	23.0
Squash	1.1	6.0	22.0
Tomato, peeled	1.3	2.2	3.7
Tomato, product	1.1	1.6	2.4
Fruit Products			
Apple	0.2	2.4	13.0
Apricot	2.5	5.6	14.0
Berry	1.8	3.5	9.1
Cherry	1.2	3.9	14.0
Citrus	0.3	3.0	9.3
Peach	1.4	3.0	6.3
Pear	1.6	3.6	7.7
Pineapple	2.6	2.7	3.8
Pumpkin	0.4	2.9	11.0

After inspection and grading, the peeled fruits are conveyed mechanically or flumed to product handling equipment for processing.

The converted fruit handling processes are can filling, syrup adding, exhausting and sealing, thermoprocessing, can cooling and storing. Processing equipment and plant floors usually are cleaned at the end of each shift and so constitute a final source of waste materials (see Figure 5-7).

Water and Wastewater Management

Several water conservation and waste prevention techniques are available by which to decrease water volume. These techniques include:

- The use of high-pressure sprays for clean-up.
- The elimination of excessive overflow from washing and soaking tanks.
- The substitution of mechanical conveyors for flumes, the use of automatic shut-off valves on water hoses.
- The separation of can cooling water from composite waste flow.
- The recirculation of can cooling water. When can cooling water is not recirculated, it may be reused in caustic soda (NaOH) or in water peeling baths, in removal of NaOH after peeling, in primary wash of the raw material, in canning belt lubrication, and in plant cleanup operations.

Figure 5-7

Wastewater Loadings Per Ton of Product from Canned Fruits	
Fruit	Flow (gallon/ton)
Apple	500,000
Apricot	500,000
Cherry	200,000
Citrus	300,000
Peach	400,000
Pear	400,000
Pineapple	50,000
Other fruit	800,000



The North Carolina Division of Pollution Prevention and Environmental Assistance provides free, non-regulatory technical assistance and education on methods to eliminate, reduce, or recycle wastes before they become pollutants or require disposal. Telephone DPPEA at (919) 715-6500 or (800) 763-0136 for assistance with issues in this fact sheet or any of your waste reduction concerns.

