Multilateral Investment Guarantee Agency

Environmental Guidelines for

Fruit and Vegetable Processing

Industry Description and Practices

Fruit and vegetable processing increases the shelf life of fruit and vegetables. The preservation of fruit and vegetables is achieved by canning, drying, or freezing, and by the preparation of juices, jams and jellies. The main steps include the preparation of the raw material (cleaning, trimming, and peeling) and cooking, canning, and freezing. Plant operation is often seasonal.

Waste Characteristics

The fruit and vegetable industry typically generates large volumes of effluents and solid waste. The effluents contain high organic loads, cleansing and blanching agents, salt and suspended solids such as fibers and soil particles. They may also contain pesticide residues washed from the raw materials. The main solid wastes are organic material including discarded fruit and vegetables. Odor problems can occur with poor management of solid wastes and effluents and when onions are processed or ready-to-serve meals are prepared.

Pollution Prevention and Control

Reductions in wastewater volumes of up to 95 percent have been reported through implementation of good practices. Where possible, measures such as the following should be adopted:

- Procure clean raw fruit and vegetables, thus reducing the concentration of dirt and organics (including pesticides) in the effluent.
- Use dry methods such as vibration or air jets to clean raw fruit and vegetables; dry peeling methods also reduce the effluent volume (by up to 35%) and pollutant concentration (organic load reduced by up to 25 percent).
- Separate and recirculate process wastewaters.
- Use counter current systems where washing is necessary.
- Use steam instead of hot water to reduce the quantity of wastewater going for treatment (this needs to be balanced with the increase in energy).
- Minimize the use of water for cleaning floors and machines.
- Remove solid waste without the use of water.
- Reuse concentrated wastewaters and solid wastes for production of by-products.

As an example, recirculation of process water from onion processing reduces the organic load by 75% and water consumption by 95%. Similarly, the liquid waste load (in terms of biochemical oxygen demand (BOD) from apple juice and carrot processing can be reduced by 80%.

Good water management should be adopted, where feasible, to achieve the following levels of consumption:

Water Usage in the Fruit and Vegetable Industry

Product category	*Water use cubic meters per metric ton (m^3/t) of product*
Canned fruit	2.5 - 4.0
Canned vegetables	3.5 - 6.0
Frozen vegetables	5.0 - 8.5

Target Loads per Unit of Production

Product	Waste vol. cubic meter per ton of unit (m^3/U^*)	BOD_5 kilograms per metric ton (kg/U)	TSS (kg/U)	Solid waste (kg/t prod)
Fruit				
Apricots	29.0	15.0	4.3	
Apples				90
-All products	3.7	5.0	0.5	
-All except juice	5.4	6.4	0.8	
-Juice	2.9	2.0	0.3	
Cranberries	5.8	2.8	0.6	
Citrus	10.0	3.2	1.3	10
Sweet cherries	7.8	9.6	0.6	
Sour cherries	12.0	17.0	1.0	
Bing cherries	20.0	22.0	1.4	
Cranberries	12.0	10.0	1.4	
Dried fruit	13.0	12.0	1.9	
Grapefruit				
- Canning	72.0	11.0	1.2	
- Pressing	1.6	1.9	0.4	
Olives	38.0	44.0	7.5	20
Peaches				180
- Canned	13.0	14.0	2.3	
- Frozen	5.4	12.0	1.8	
Pears	12.0	21.0	3.2	200
Pickles				
- Fresh packed	8.5	9.5	1.9	
- Process packed	9.6	18.0	3.3	
- Salting stations	1.1	8.0	0.4	
Pineapples	13.0	10.0	2.7	
Plums	5.0	4.1	0.3	
Raisins	2.8	6.0	1.6	
Strawberries	13.0	5.3.	1.4	
Tomatoes				60
- Peeled	8.9	4.1	6.1	
- Products	4.7	1.3	2.7	

Product	Waste vol. (m^3/U)	BOD_5 (kg/U)	TSS (kg/U)	Solid waste (kg/t prod)
Vegetables				130
Asparagus	69.0	2.1	3.4	
Beets	5.0	20.0	3.9	200
Broccoli	11.0	9.8	5.6	
Brussel sprouts	36.0	3.4	11.0	200
Carrots	12.0	20.0	12.0	
Cauliflower	89.0	5.2	2.7	
Corn				40
- Canned	4.5	14.0	6.7	
- Frozen	13.0	20.0	5.6	
Dehydrated				
- Onion and garlic	20.0	6.5	5.9	
- Vegetables	22.0	7.9	5.6	
Dry beans	18.0	15.0	4.4	
Lima beans	27.0	14.0	10.0	
Mushrooms	22.0	8.7	4.8	
Onions, canned	23.0	23.0	9.3	
Peas				40
- Canned	20.0	22.0	5.4	
- Frozen	15.0	18.0	4.9	
Pimentos	29.0	27.0	2.9	40
Potatoes				
- All products	10.0	18.0	16.0	
- Frozen products	11.0	23.0	19.0	
- Dehydrated products	8.8	11.0	8.6	
Sauerkraut			0.6	
- Canning	3.5	3.5	0.2	
- Cutting	0.4	1.2		
Snap beans			2.0	
- Canned	15.0	3.1	3.0	
- Frozen	20.0	6.0		
Spinach			6.5	
- Canned	38.0	8.2	2.0	
- Frozen	29.0	4.8	2.3	
Squash	5.6	17.0	12.0	
Sweet potatoes	4.1	30.0		

Source: Adapted from Economopoulos 1993.

Fruit juices	6.5
Jams	6.0
Baby food	6.0 - 9.0

Solid wastes, particularly from processes such as peeling and coring, typically have a high nutritional value and may be used as animal feed.

Target Pollution Loads

Implementation of cleaner production processes and pollution prevention measures can provide both economic and environmental benefits. The target loads per unit of production in the above table can be achieved by implementing measures such as those detailed in the previous section. The numbers are the waste loads arising from the production processes *before* the addition of pollution control measures.

These levels are derived from the average loads recorded in a major study of the industry and should be used as maximum levels of unit pollution in the design of new plants.

Treatment Technologies

Preliminary treatment of wastewaters should include screening (or sieving to recover pulp) and grit removal if necessary. This is followed by pH adjustment and biological treatment of the organic load.

The flows are frequently seasonal, and robust treatment systems are preferred for on-site treatment. Pond systems are used

successfully to treat fruit and vegetable wastes but odor nuisance, soil deterioration, and groundwater pollution are to be avoided. The quality of the effluent is normally suitable for discharge to municipal systems, but peak hydraulic loads may cause a problem. Odor problems can be avoided by using gas scrubbers or biofilters.

Emission Guidelines

Emission levels for the design and operation of each project must be established through the Environmental Assessment (EA) process, based on country legislation and the *Pollution Prevention and Abatement Handbook* as applied to local conditions. The emission levels selected must be justified in the EA and acceptable to MIGA.

The following guidelines present emission levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance, including MIGA guarantees; any deviations from these levels must be described in the project documentation.

The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable.

All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Liquid Effluents

The following effluent levels should be achieved:

Effluents from Fruit and Vegetable Industry

Parameter	*Maximum value milligrams per liter (mg/L)*
PH	6 - 9
BOD_5	50
COD	250
Total suspended solids	50
Oil and grease	10
Total nitrogen	10
Total phosphorus	5

Pesticides may be present in significant levels, therefore testing should be performed and, if pesticides are present at levels above 0.05 mg/L, corrective action should be taken. A change to a supplier of raw material without pesticide residues is preferred.

Note: Effluent requirements are for direct discharge to surface waters.

Solid Wastes

Whenever possible, organic wastes should be used in the production of animal feed or organic fertilizers. Other solid wastes should be disposed of in a secure landfill so as to avoid surface and groundwater contamination.

Ambient Noise

Noise abatement measures should achieve either the following levels or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

Ambient Noise

	Maximum Allowable L_{eq} (hourly), in dB(A)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The emission requirements given here can be consistently achieved by well-designed, well-operated and well-maintained pollution control systems.

Monitoring and Reporting

Monitoring of the final effluent for the parameters listed above should be carried out at least once per month, and more frequently if the flows vary substantially. To estimate water usage in various production processes, the wastewaters from unit operations should be monitored during each product season or, at a minimum, annually.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. These should be reported to the responsible authorities and relevant parties, as required, and provided to MIGA if requested.

Key Issues

The following box summarizes the key production and control practices that will lead to compliance with emissions guidelines:

- Implement water conservation and recycling measures.
- Adopt dry cleaning and peeling methods.

Further Information

The following are suggested as sources of additional information (these sources are provided for guidance and are not intended to be comprehensive):

Economopoulos, A.P. 1993. *Assessment of Sources of Air, Water and Land Pollution.* Part One: "Rapid Inventory Techniques in Environmental Pollution." Geneva: World Health Organization.

World Bank, Environment Department. 1996. "Pollution Prevention and Abatement: Fruit and Vegetable Processing." Technical Background Document.