CANNERY WASTE DISPOSAL

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The amount of waste, both solid and liquid, produced in canning operations is frequently enormous. Consisting largely of carbohydrate material from fruits and vegetables, these wastes rapidly undergo decomposition and, if discharged into a receiving body of water, may result in pollution. Public demand for streams and lakes suitable for fishing, bathing, and other recreational purposes, and as sources for industrial and municipal water supplies, has resulted in legislation designed to protect these natural sources of water. As industries multiply and cities increase in population, additional quantities of waste are being discharged. For the canning industry, the situation is aggravated by its activities being concentrated largely during the summer months—a time when streams and lakes are least able to assume an added burden. High temperatures, low stream flows and active biological life all tend to reduce the amount of dissolved oxygen available for oxidation of organic material from food plants.

The methods available for the disposal of solid waste and liquid waste are entirely different. It is therefore necessary to collect the two types of waste separately within the factory if that is possible, or to separate them by screening when the two are combined.

Solid wastes arise from the food material itself (rejects, trimmings, inedible parts, adhering soil). Liquid waste usually contains two types of solids: one which is particulate and suspended in solution, and one which is in true solution. Regardless of the ultimate disposal method, it is desirable to remove by screening as much of the suspended solids as is economically feasible. Failure to screen the wastes causes unsightly conditions in streams due to floating solids from which foul odors may be produced, overloads lagoons or digesters if this type of treatment is given, and may clog filters and distributors if discharge is to a sewage treatment plant.

Another advantage for separate collection of solid waste is that it would be relatively dry. This is an important consideration when solids are dried further for animal feed. Solid wastes free from adhering water are easier to handle and do not require water-tight compartments when disposed of by hauling away. Every effort should be made to prevent solids from entering factory drains. Solid wastes are sometimes dewatered by means of a tomato cyclone. Also, disposal may be by spreading over farm land or by removing to dry beds from which it is later piled and burned.

Screening is required by most states as a pollution control measure if the waste is to be discharged to public waters, and no intentional maceration, grinding or comminution of gross solids is allowed in order to pass the solids through a regulation size screen.

The disposal of liquid wastes generally presents the most critical disposal problem to food processors. Large volumes of water are used to wash fruits and vegetables and to maintain sanitary conditions in the plant which accounts for the vast amount of liquid waste. Some form of treatment is generally necessary or will be demanded as antipollution laws are enacted and enforced. In order to properly appraise a particular situation, the following data should be obtained: Volume and characteristics of each type of waste water produced, degree of treatment required, area and topography of land available for a treatment plant, possibilities of utilizing local municipal treatment works if any exist or are contemplated, and financial considerations. Consideration must again be given to the fact that most food processors of the type being considered operate on a seasonal basis, which does not justify the capital expenditure for waste treatment that could be borne by a plant operating throughout the year. After obtaining the basic information with regard to the waste, treatment by one or by a combination of the following methods can be considered: discharge to a municipal treatment plant, biological filtration, chemical precipitation, discharge to an impounding lagoon, or land absorption.

Municipal Treatment Plant

The treatment of food wastes at municipal treatment plants is an ideal solution when the city plant has sufficient capacity to handle the added volume and pollutional load. Before discharge to the municipal plant the waste should
be screened and possibly pretreated. Municipal treatment plants of both the biological filtration and activated sludge type are successfully treating food processing wastes. The financial arrangement between industry and the municipality is, in the last analysis, the determining factor.

**Biological Filtration**

Biological filtration on the scale necessary for a high degree of treatment of strong factory wastes can well be prohibitive in cost for the seasonal food processor. The large initial investment can be reduced somewhat by the use of high rate filters with recirculation, but only at the expense of additional operating costs. Any type of biological filter not in continuous use must be conditioned before reaching maximum efficiency. This means either that the filter is operated for several weeks inefficiently or that the filter must be artificially conditioned prior to use. Some fruit and vegetable wastes may be deficient in mineral nutrients, particularly nitrogen, required to maintain an active biological growth in the filter. While research data indicate that biological filters are capable of a high degree of treatment, the installation of filters should be considered only as a last resort, for the present.

**Chemical Precipitation**

The use of chemical coagulants have been used occasionally to reduce the strength of screened wastes. Lime followed by either ferrous sulfate or alum is generally used in treatment plants operated by food processors. If properly conducted, chemical treatment will remove suspended and colloidal solids, but not such materials as sugars which are in true solution. The degree of treatment will therefore depend upon the relative proportion of suspended and colloidal solids to soluble organic solids. In general, chemical precipitation has the potential of removing 50 per cent of the pollutional material. It has proved satisfactory where stream dilution has been sufficient to absorb the residual biochemical oxygen and also as a means of pretreatment prior to discharge to a municipal treatment plant. Future work is contemplated to find the chemical which will reduce the strength of the waste.

**Impounding Lagoons**

Impounding cannery waste in storage lagoons offers a means of disposal which eliminates stream pollution and may be less expensive than other methods of treatment. Storage of liquid waste in earthen ponds allows partial or complete decomposition of the waste, after which the waters can be discharged to a water course or to a municipal plant for further treatment. Where soil conditions are favorable complete absorption into the soil may be obtained. The possibility of polluting underground water must be considered.

If topographic features permit, it is preferable to construct a single large lagoon rather than several small ones. It requires about two weeks to establish in the lagoon the desired growth of aquatic plant and animal life. Once established, they act quickly upon incoming fresh waste.

A large shallow lagoon rather than a small deep one is recommended, not only because of better natural aeration, but because the stimulating effort of sunlight on biological life within the lagoon is effective on a larger proportion of the waste. If sufficient land is available, a liquid depth of about three feet is suggested. A depth of five feet is the maximum which should be used.

The use of lagoons by food processors has been limited by the ability to secure isolated lagoon sites where odors would not create a nuisance. Sodium nitrate will eliminate or reduce lagoon odors according to the amount of nitrate added. The function of sodium nitrate is threefold: (1) to furnish oxygen available for aerobic bacterial decomposition, (2) to stimulate the growth of chlorophyllaceous organisms which in turn produce additional oxygen by photosynthesis, and (3) to maintain an alkaline reaction. In recent years, there have been introduced on the market several odor masking agents as well as some other materials intended for odor control in lagoons. Some of these agents appear to work, but the masking odor may be objectionable as well.

**Land Absorption**

Screened liquid wastes may be disposed of by soil absorption in localities where soil conditions will permit rapid absorption. Several methods of application are in use. In one, furrows approximately 24 inches wide at the top, 15 inches wide at the bottom, and 9 inches deep act as receiving channels for distribution of the waste over the field. Again, precautions should be taken to prevent underground seepage from polluting wells.

Spray irrigation of waste waters is an adaptation of agricultural watering using a portable sprinkler system. Waste irrigation aims to use
the minimum amount of land area with a maximum of waste application without damaging the vegetative crop.

There are four reasons why a properly operated spray irrigation system is attractive to canners. These are:

1. Relative economy as compared to other methods of treatment;
2. Complete elimination of stream pollution. Stringent stream pollution requirements and enforcement make any workable treatment welcome;
3. Absence of odor;
4. Potentials that may benefit the canners, such as:
   a. recharge of ground water,
   b. possible nutrient addition to the soil,
   c. possible irrigation of edible crops.

Probably the most critical factor to consider for spray irrigation is the availability of land within an economical pumping distance. As to the area necessary, it may be generally stated that there must be sufficient land area to handle peak waste loads without overloading.

NEW METHODS

A new method of waste disposal for solid waste now being investigated by our Berkeley, California Research Laboratory is that of high-rate aerobic composting. Because the high moisture concentration in the fruit and vegetable wastes must be reduced, the composting method under study requires the use of dry diluents for which methods of disposal or utilization are also needed. Dry materials such as tree bark, sawdust, wood chips, dry municipal garbage, and cereal grain refuse are needed to control the moisture content.

Peach pits show promise as a raw material for the manufacture of charcoal briquettes. Prior to this they have been buried, pulverized or burned which has not proven satisfactory.

Large quantities of organic material responsible for the high pollutional strength of liquid wastes can be removed by a trickling filter treatment. This method shows great promise as an economical means of eliminating pollution.

From this discussion, we hope that you have a clearer picture of the problems of waste disposal in the canning industry. With the expected population boom these problems will become larger and larger. We hope that we can stay one step ahead of them, in fact we must, but this will mean ever greater effort and, let’s face it, more expense.

THE TASTE OF CITRUS JUICE:
IV. Imitations and Drinks

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The taste interrelationship of sugar, acid and salt plays an important role in characterizing various fruit juices. The taste interrelationship in tomato juice was reported recently by Pangborn (2). Taste interrelationship of sugar, acid and salt in citrus reported in 1958 by Kilburn (1). In this work, the relationship between acid and sugar was expressed as the Brix/acid ratio. The relationship between acid and salt was expressed as pH. The interrelationship was determined by a scattered diagram, using the log of the Brix-acid ratio as ordinate, and the pH as abscissa.

Data obtained from the State Fruit Inspection Service were graphed over a three year period. Data from laboratory examination of concentrated orange juice samples were also plotted. The resulting regression line was a straight line function and identical for all varieties of citrus. This functional representation of the interrelationship is shown in Fig. 1 as the solid line labeled “juice.” Normal samples of juice, yielding data which fall exactly on the line, can be rigorously defined with regard to relative tartness of taste. The closer the point is to the origin the more tart the juice will taste. For example, lemon juice at the lower end of the line is far more tart than grapefruit juice half way up the line in Fig. 1.

Points which do not fall exactly on the line, because of abnormal composition or modification