# Water Conservation and Process Water Utilization in the Beet Sugar Industry

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There has been an increasing industrial trend toward the conservation of process waters and the utilization of waste waters. This trend has been prompted by a number of factors. Increased population and industry have increased the direct use of water and the people attracted to man these industries have created an increasing demand for usable water for domestic purposes. In some areas there is direct competition between water for agricultural purposes and water for industrial and domestic use. This has resulted in new legislation and the formation of County Water Districts in some areas in California which are designed to regulate and control water consumption. In other areas numerous surveys have been made and are being made to serve as the basis of equitable allocation of water resources as well as to forecast the long range requirements of the community, county, area or state.

In the sugar industry areas principally affected, stimulation for water conservation and process water utilization has come from causes such as:

1. Lower water levels at plants supplied by deep wells.
2. Encroaching population near the factory site, making reduction of the nuisance value of waste disposal necessary.
3. Pollution problems of streams, bays and other common waters whose public use has increased to the extent that regulation is necessary.

Reduction in waste water production does not reduce the net output volume of solids and B.O.D. except in those instances in which special processes have been installed to utilize these solids. The dilution of waste does not reduce the poundage of solids and B.O.D. to be disposed of and is becoming a restricted practice, forcing the industry to adopt other methods. The handling and disposal of waste waters at many plants is an increasingly chronic problem.

Lowering waste water output is possible by several means, the two principal and most effective ones being the reuse of fresh water to the greatest possible extent and the utilization of process waters, with treatment if necessary, by reintroduction of as much of this water as possible into the factory processes replacing fresh water.

A third method is the disposal of some of the more objectionable solids to by-products plants as is done in the concentration of Steffen filtrate for ultimate use as a source of MSG. This removes one of the most difficult solids and B.O.D.-containing factory wastes, which have a high nuisance value at some factories, and passes the ultimate disposal problem to the

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MSG manufacturer. The latter, however, has made yet another salable byproduct from this waste after extracting the MSG and has greatly alleviated his disposal problem.

Fresh water conservation by reuse is primarily accomplished by returning all condenser waters not needed for other purposes to a hot well and cooling same over natural or forced draft cooling towers. Fresh water from wells or other sources is usually added as makeup from a fresh water supply tank by overflow to the condenser supply tank or it can be added to the cold well or cooling tower basin and pumped into the plant as a common or single water supply system.

Water from the condenser seal tanks at somewhat elevated temperatures provides most of the diffusion battery supply water and the excess is returned to the hot well for cooling and reuse. Usually evaporator and pan condensates are used for boiler feed water and the excess hot water from these sources used for press wash and general hot water requirements. Any excess, including other condensates from plant evaporator and heating-processes, goes to the battery supply where condenser seal water is used for makeup. In cases of temporary oversupply the overflow should go back to the cooling tower hot well and not to the sewer.

Another common water conservation practice is the recirculation of water used for fluming beets. Makeup water for fluming is drawn from the general water supply through the beet washer or is added to the flume water pump sump where there is no beet washer. Where a waste water treatment is used for the final plant effluent a system of pump sumps, with overflow in the proper order, preserves the quality of the flume water to some extent whereas in other systems all drainage waters from the plant processes, including Steffen houses and pulp driers, are screened and a portion equal to the input and overflows from the various sources is pumped out as final waste while the flume pump draws from this same source, recirculating this water through the flumes.

In the overflow sump system, Steffen waste, pulp silo underdrainage, lime and sludge pond drainage and other less desirable waste waters can be added to the sump ahead of the treating plant or to the final sump leaving the plant if no treatment is involved. The flume pump sump then is returned flume water plus makeup, and the percent of discard is regulated by the makeup and other fixed discharges from the plant such as final pulp cell water, battery washout water, etc.

A further degree of economy in fresh water requirements and a further reduction in final waste water volume has been achieved at a number of plants for several years by returning pulp separator water to a reserve tank to be used as battery washout hose water and pulp pit fluming water. All plants having conventional pressure batteries have this water disposal problem whether wet pulp silos or pulp driers are utilized for final pulp disposal. Continuous diffusers discharge drained pulp, thereby eliminating one source of waste water.

The next and latest step in the conservation of water is the product of necessity brought on by increasingly difficult disposal problems. This is the utilization in the process of previously wasted process waters and is accomplished in a number of ways. There are several methods requiring some treatment of the water and at least one which reintroduces pressed pulp water into the diffuser without any treatment.

Another process utilization practice consists of treating pressed pulp water to effect a partial purification by the elimination of solids through fioculation and settlement. The clarified water is then used in the Steffen process to make up cooler solution. In this manner, the sugar remaining in the water goes through further purification and is partially extracted as saccharate. The solids in this process can be discarded as sludge or, being high in protein, can be mixed with molasses going to a pulp drier, thereby becoming a portion of the dried pulp. There are other clarification processes utilizing chemical fioculation, the treated waters being added to the diffusion battery as part of the battery supply. Some of these are the results of European development as well as work done in the American industry.

Each of the progressive steps in the conservation of water and the utilization of process water requires increasingly extensive plant facilities and, generally speaking, the extent of the effort in this direction is dictated by local conditions. In the case of simple reuse of fresh water the added plant facilities include considerable large underground piping for the return of condenser water seal tank overflow to the hot well, a large hot well to tower pump and auxiliary, a cooling tower and a cold water reservoir. In addition, pumps returning this water for reuse in the condenser system are required as are large underground lines, usually of some length, to handle the water to the plant condenser water tanks. If the cooling tower is a forced draft type there is an added major horsepower requirement in running the fan or fans of the unit. It is evident that there are extensive first costs and maintenance costs of facilities for this water conservation step.

The recirculation of flume water is a relatively simple and widely used method of cutting down the consumption of fresh water. It becomes more complicated when waste water treatment of the plant final effluent is incorporated. This requires a gravity collecting system for the factory main sewer or sewers with a pumping plant which in its most complex form does the following:

The flume water returning from the factory, plus selected drainage, is recirculated with a flume pump. The excess flume water plus the less desirable waste waters such as Steffen waste are pumped from the following compartment to the treating plant and the effluent from the treating plant flows to a collecting sump from which it is pumped to the disposal area, which can be a river or other body of water or prepared land for direct land disposal. This system involves several large pumps, a collecting basin with screens, and several hundred feet of usually large pipe line, and the power requirements are considerable.

The return of pulp separator water for factory purposes replacing fresh water generally used for battery washout normally requires many hundreds of feet of large pipeline, but if elevations are suitable no pumping is involved. Corrosion and maintenance are generally high on the tanks and lines used in the system.

The utilization of process waters has been accomplished in several ways but not without substantial investment in plant and some added power consumption. There is some confusion regarding the maintenance problems in the systems, but they are generally high because of corrosion. Some of these processes make claims for recoverable values which partially offset the operating costs, whereas in the other instances mentioned the only accomplishment is the elimination of a problem to meet local conditions with no monetary return.

It has been stated by Weckel (1)[2] that if all of the methods of elimination are used it is plain that the magnitude of the (waste) disposal problem of a beet sugar factory can be reduced. It appears entirely possible that by applying present knowledge the waste disposal load can be reduced to about 10 percent of that of a factory which practices no process water utilization and byproducts production such as the concentration of Steffen filtrate. No calculation has been made showing the results achieved by a typical maximum water conservation program but in many instances it has been established that the fresh water requirements and the flow of water from the plant can be reduced by as much as half or more, using combinations of the methods described.

### Literature Cited

(I) WECKEL, W. O.
____. Beet Sugar Technology p. 475.

[2]Numbers in parentheses refer to literature cited.