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Wastewater Minimization and Treatment

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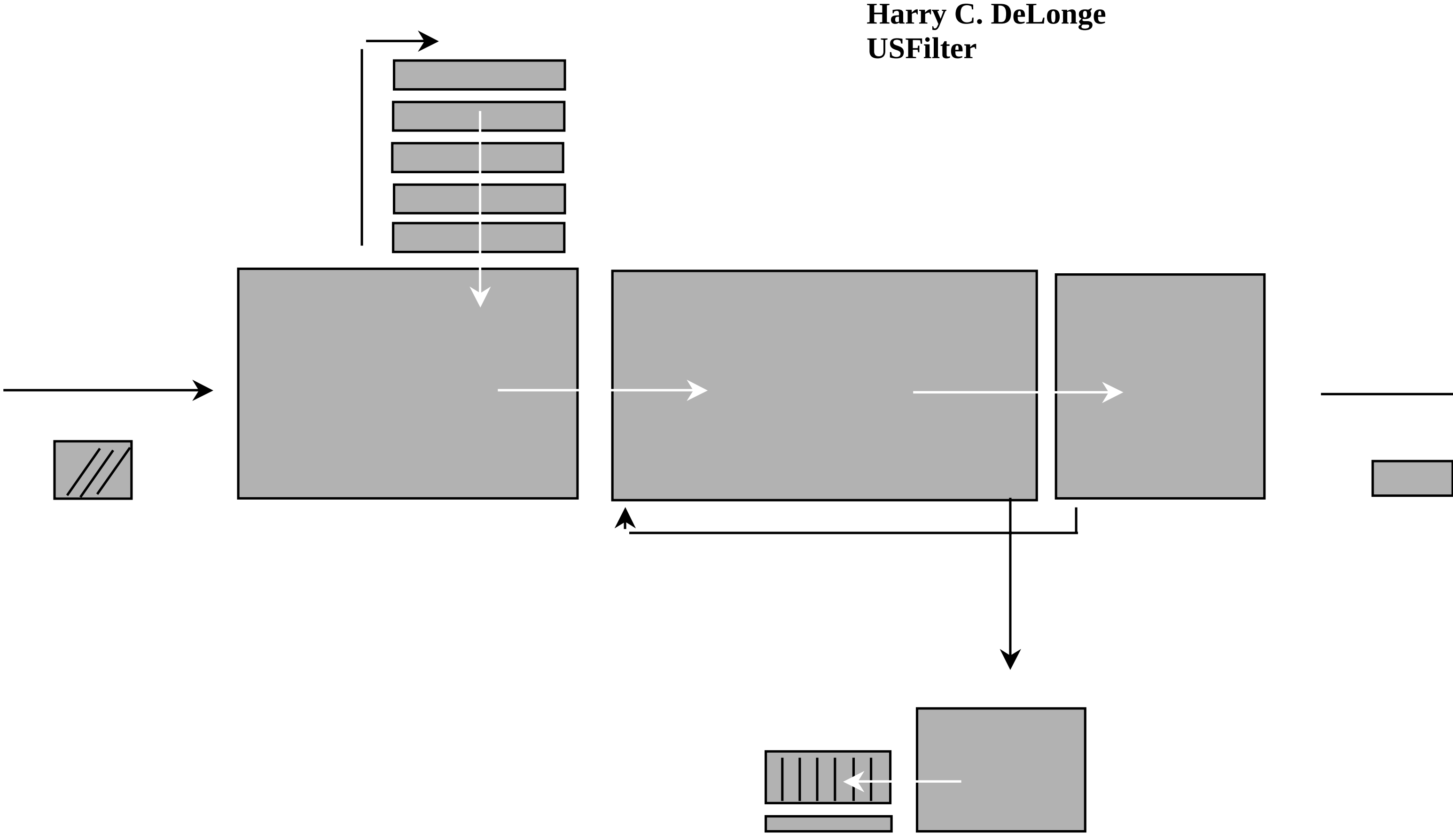

Wastewater Minimization and Treatment

Wastewater Minimization / Reduced Water Consumption

Basic Strategy
- Minimization, Recycle and Reclaim Opportunities
- Quality Philosophy and Parameters

Need to conserve water and to use it efficiently
Keeping operational excellence
Reduce consumption while improving performance
Audits (pre and post)

Plant Effluent - What to expect

Regulatory Compliance and Sewer Surcharges
Basic Plant Effluent Characteristics
- Non-Returnables (PET, cans, glass)
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Contribution of Water Treating Technology to Waste Stream

Treatment Technologies

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Anaerobic
Aerobic / aerobic
Anaerobic / aerobic
Tertiary
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Membranes
Evaporation and Crystallization
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On a "Global" basis, efficient use of water … and cost effective handling of plant wastewater … have become "Hot" topics. They have become critical operating, cost and "regulatory compliance" factors in how we run our beverage plants.

The purpose of this presentation is to detail the impact of water usage and address wastewater disposal. Our specific agenda:

1. Efficient water usage
2. Water minimization tools (recirculation, recycling, reclamation)
3. Wastewater treatment and surcharge reduction

Wastewater Minimization / Reduced Water Consumption

It is no longer just politically correct to be sensitive to water conservation concerns, it has become a major cost and operational hot spot. Water costs money, and you pay again for what goes to the drain. In many cases plants now face limits on the amount of water they can draw off for production and plant purposes.

- Basic Strategy ...

  For effective optimization of water usage we need a battle cry. We need to stay on the sides of the angels. An effective position is to demand that any measure that saves water must do a superior job to what you are doing now. This can almost always be accomplished. Saving water by giving away a margin of safety is not an acceptable alternative in the food industry.

  - Minimization, Recycle and Reclaim Opportunities
  - Quality Philosophy and Parameters

- Need to conserve water and to use it efficiently ...

  In performing plant audits it is almost a fact of life that you will find streams of water being discharged that cannot be accounted for without a thorough search. Examples ... a stuck valve on an exchanger ... a leaking rinse water tap ... small, but even a small flow quickly loses thousands of gallons of water.

- Keeping operational excellence ...

Water that goes to the drain should have performed a task, or a number of tasks, with a high degree of efficiency. Using hard water for rinses and heat exchange purpose will slowly degrade the effectiveness of that operation. Softening water, keeping it clean and sanitary and, where advantageous, adjusting to an optimum pH, are tools that can enhance the efficient use of water.

- Reduce consumption while improving performance

Many plant functions and operations that use water can be improved while reducing the amount of water involved. Using recirculation, recycling or reclamation can allow faster flows with less consumption.

Even cascade approaches, common to the food industry, done with knowledge and good controls can save a significant volume of water, reduce flow to the drains, and improve quality and performance.

- Audits (pre and post)

Plant audits can be a valuable tool for determining how much water is being used by the various packaging plant areas and functions, and comparing this against equipment operational needs as recommended by the manufacturer and the plants own experience.

Such audits usually identify water streams that represent wastage or overuse. They also become an excellent database to identify opportunities for water savings or where water reclamation or recycling will have an important impact.

The third key to an audit is to quantify water savings based on changes made and to confirm that both quality and performance have been improved.

Audits are most effective when they actually measure flows and are backed up by chemical, microbiologic and operational test results and quantification.

Plant Effluent - What to expect

Every plant will offer a different “effluent”. Part of this has to do with the type of package being filled, and part as to the type product. A beverage with sugar or High Fructose will contribute significant BOD … A Diet product or bottled water will offer near zero.

BOD	Biochemical Oxygen Demand
BOD5	5 Day Biochemical Oxygen Demand
COD	Chemical Oxygen Demand

Most beverage plants discharge a waste stream that is easy to treat by the municipality and contains few inhibiting characteristics or contaminants of concern. The great majority of the BOD and COD are high fructose or sugar. The two main points where BOD and COD originate are the syrup room and the filling areas.

- Regulatory Compliance and Sewer Surcharges

  There are two basic compliance issues being encountered by beverage plants related to plant effluent:

  1. High sewer surcharges

     Plant wastewater effluent can result in sewer surcharges that are often a significant cost factor. Usually the charges are based on a number of parameters, including flow, but weighted heavily to the BOD or COD load.

  2. Compliance pressure to build a wastewater treatment facility

     Municipal wastewater facilities can not handle the load (or do not exist) and the beverage plant is forced to build a wastewater treatment plant. A wastewater treatment plant for even a small beverage plant can easily be an investment of over $1MM depending on the point where the wastewater is discharged and the compliance levels (BOD/COD) required.

- Basic Plant Effluent Characteristics

  In the United States most beverage operations use non-returnable containers. With little rinse water used on the production line, flows to the drain are relatively small but the concentration or load (BOD) is high. Returnable bottles that are washed and rinsed before filling easily use twice as much water … but the loading per gallon is low.

  - Most suspended solids come from the water treatment room and are contributed by backwash waters or sludge from coagulation systems.

  - The pH is normally low (5 – 7) for non-returnable operations and high (over 8.0) for Returnables.

  - The following are values that would be typical of a soft drink plant waste stream (average) when all products contain sugar or High Fructose:

	BOD5 (mg/l)	COD (mg/l)
Non-Returnables (PET, cans, glass)	1500 – 3000	2200 - 4500
Returnables (glass, returnable PET)	700 – 1200	1000 - 1700
Syrup and Pre-Mix Transfer Tanks)	*	*

* Depends on type of operation (BIB, SS transfer tanks Post-Mix/Pre-Mix, Jugs, Cartons)

- For untreated wastewater, when the plant uses sugar or high fructose, the BOD5 usually averages near 70% of the COD

- Contribution of Water Treating Technology to Waste Stream

  While the water treatment systems used in beverage plants do not contribute a significant biologic load, they are a major contributor of wastewater and the single largest source of suspended solids going to the drain.

  - Where membrane technology is used, the majority of suspended solids come from backwash waters used for carbon towers and multi-media filters. Concentration of the sediments in the incoming raw water is a second source of suspended solids but not normally to a level of concern. This is an excellent "target" for water reclaim but there are major issues with pathogens (Cryptosporidium) to be addressed.

  - For coagulation systems, particularly when Lime is used for alkalinity and hardness reduction, the suspended solids are heavy coming from both the backwashing of carbon towers and sand filters, and from the periodic dumping of sludge from the coagulation tank.

Wastewater Treatment Technologies

The selection of treatment technology depends on the strength of the BOD load, and the discharge standards that have to be maintained. A key factor will be in preparing for future products and packaging.

For beverage operations where the average discharge is at 300 to 1200 mg/l BOD5, aerobic based systems have advantages. Where BOD5 levels are higher, anaerobic processes have advantages. Quite often a combination of technologies such as aerobic/aerobic and anaerobic/aerobic work best.

- Regulatory Compliance

  Discharge parameters that are established should be taken seriously and in-plant monitoring protocols established. Testing can be in-house or using an experienced outside laboratory.

  The usual parameters established deal with BOD, COD, TSS, pH and flows.

BOD and COD are the most difficult to reduce or control, and represent the greatest investment.

- Conventional Wastewater Systems and Expected Performance

  Conventional wastewater systems used in the beverage and food industry cover sophisticated biologic systems to aerated lagoons. Almost all commonly encountered technologies will also be found treating wastewater from beverage plants. Many technologies are not “smart” for these applications since there is a tendency for filamentous growth or “bulking” due to so much of the waste being in a form of sugar and at high levels. This is further complicated by the switching from sugar to “Diet” in production runs.

- Aerobic

  Aerobic processes such as trickling towers, roughing filters, activated sludge and extended aeration essentially reduce BOD and COD by supporting the growth of organisms that digest organic matter. The strength of aerobic technologies is that the systems are predictable and controllable to a good extent and will reduce organic loads to the desired levels.

  A weakness, is that high strength wastewater can promote filamentous growth in some processes, presenting a potential for the process to die off. A secondary weakness in comparison to anaerobic systems is the large volume of sludge.

- Anaerobic

  Anaerobic processes are new to the beverage industry but gaining in popularity because of two strengths:

  1. The ability to handle high strength wastewater (BOD over 2000 mg/l)

  2. A significant decrease in the amount of sludge to dispose of

  Weaknesses in anaerobic processes are that they can be severely stressed with a weak wastewater and require a long startup period.

- Aerobic / aerobic

  Aerobic/aerobic processes are excellent for beverage plants using returnable packages or where there is a healthy mix of production with high fructose or sugar … and … “diet” products or water.

  Such plants, properly designed and correctly operated, have little difficulty in achieving and maintaining BOD5 discharge levels of 30 mg/l. They can be enhanced or incorporate tertiary support systems to go lower but this usually increases investment spending considerably.

- Anaerobic / aerobic

  The strength of anaerobic processes is that it can handle high strength waste streams and greatly reduce the volume of sludge. An anaerobic system can take a considerable amount of time to start up, and needs help in reaching BOD5 levels normally required for many sites (at 30 mg/l for example). Blending together anaerobic/aerobic technology is an excellent approach for many beverage plants particularly non-returnable operations having only sugar and HFS products.

- Tertiary

  A number of processes can be incorporated into a wastewater plant that can be considered tertiary treatment. Membrane technology, carbon towers operated in a manner to support growth and encourage bacterial activity, are both effective devices as are biologic "gardens" where natural degradation is enhanced.

- Chemical/Physical

  Chemical/Physical systems are encountered in almost all wastewater treatment processes but in a supportive role … seldom as the primary treatment technology. Grease and oil traps, solids removal and sludge handling, chemical and nutrient feeders, are all key parts of a biologic process. Coagulation, filtration, etc are only used to address special contaminants or circumstances.

- Pre-Treatment or Partial Treatment of Plant Discharge

  Where compliance levels are relaxed (>400 mg/l BOD) or where a plant wants to lower sewer surcharge costs, pre-treatment and/or partial treatment are viable options. Processes preferred are those where the need for labor and controls are minimal or non-existent.

- Alternative Approaches and Emerging Technology

  New technologies are rapidly becoming available to engineers designing wastewater systems:

  Membrane technology (RO, nano-, UF, micro)
  Thermophilic processes with strong advantages
  Pathogen control, particularly in sludge handling
  Crystallization and zero discharge options
  Tertiary (membranes, carbon technology, natural processes)

- Membranes

Membrane technology is becoming more of a wastewater "tool" both from the standpoint of concentrating contaminants and therefor also reclaiming a water stream for plant facility use. This also presents the possible reclamation of sugar solids for possible sales opportunities, or to make disposal easier or cheaper.

- Evaporation and Crystallization

  Evaporation will reduce the volume of a wastewater allowing for easier disposal of a reduced volume of the concentrated BOD, COD, and TSS. Where this can be hauled away by a licensed contractor it can be a cost effective solution particularly if the concentrate is free of toxic or dangerous ingredients and can be used for agricultural purposes or for the production of alcohol.

  When considering zero discharge options evaporation and crystallization are two "tools" to consider.

- Sludge Processing

  Handling of sludge in biologic systems is usually accomplished by digesting the sludge to reduce volume and then using a press or centrifuge for dewatering. The pressing can be with a plate and frame or with a belt system. New approaches with plate and frame now include a system that uses elevated temperature to achieve a pathogen kill.

  Designing the sludge handling function of a wastewater plant is often overlooked from the standpoint of compliance issues for a plant location, and in projecting operating costs.

- Zero Discharge

  A number of zero discharge options exist that utilize a combination of technologies. Evaporation, crystallization, natural degradation and utilization, and others that can be expensive or reasonable investment alternatives depending on location, regulatory constraints, and driving forces.

Operating Options

- In-Plant Function

  Operating a wastewater treatment plant is not a normal function in a beverage plant. The technology is very different and the test protocols and methods of control require a perspective more familiar to microbiologists and biologists. The treatment systems operating most successfully in beverage plant recognize this early and train accordingly.

It is also important to use automation that includes simulation and diagnostics, keeping in mind that the operation is really at work 24 hours a day, 365 days a year. If the air supply shuts down in an aerobic system, the system is in danger of going down with the clock ticking on bacteria survival. Cleaning up after a disaster is hard work and start-up is always an issue. With an anaerobic system shutdowns cause little concern but if the plant feed is too "weak" the organisms are stressed and again a clock is ticking.

When the system is designed, outfitted and built correctly, and the beverage plant has a trained staff, operation is simple to control. The wastewater is relatively safe, and predictable, and staffs build experience quickly.

- Outsourcing

Most beverage plants do not agree with outsourcing their water treatment operation considering this a "core competency" issue. In the case of wastewater treatment there are financial and regulatory advantages that are significant and the issue of those skills being in the beverage plant are arguable.

Outsourcing wastewater treatment, or even going with a build, own, operate installation can be highly cost effective, reduce investment spending by over a million dollars, and remove the concerns over managing a separate operation. It also places regulatory compliance documentation and protocols in the hands of staff experienced in this part of the job.

Conclusion - Key Take-Aways

- Biodegradability and waste charectorization

Establishing the degradability of a waste stream for existing plants is a simple task and should be rechecked every time new plant chemicals are used or at the first sign of treatment difficulties. Line lubricants can have microbiologic inhibitors as part of their formula, and then have this ingredient affect bacterial action in the waste treatment plant. A simple problem to correct. For new plants an ingredient by ingredient check should be made of the chemicals that will be used in the plant. Most often this will help to identify potential problems.

Waste characterization is simply an analysis (24 hours a day for a measures time and season) of plant flows to confirm flow rates, loading and surge patterns. Critical for sizing equalization tanks and establishing an optimum flow rate for most systems.

- Product line changes and the "Impact"

A fact of life in the beverage industry is that product and package changes will happen … and plants expand or change their focus on operating needs. Any wastewater system should be designed and built based on the premise of "change". This is critical and the flexibility for such radical changes can be established easily … if part of the planning process. Do not design and build for the future. Better to build for now and what you are absolutely sure of … and leave room to expand or add on. For food and beverage plants, and for many other industries, the dangers to building too big are almost as bad as building too small.

- Do not build unless left with no other option

  Absolutely the most important take-away. Avoid building a wastewater treatment plant unless forced to. An unneeded expense, takes up room, an unfamiliar operation … and probably does not belong in a food plant. Most municipalities will listen to argument and review other options. There are usually alternatives.

Thank you