Innovations in Minimizing Waste and Wastewater Effluent from Food and Beverage Processing Operations

Best Management Practices

Aspects to be explored in this Module…

- Mechanisms to encourage Ontario's food processing industry to adopt Best Management Practices and to foster a culture of continuous improvement;
- Barriers to adopting Best Management Practices (BMP) in the food processing industry;
- An approach and solution to these barriers;
- Opportunities and barriers to implementing new technology;
- A potpourri of BMP ideas for selection and expansion by companies who want to get started.

Challenge…Innovate…Succeed

Introduction

This module reviews and identifies mechanisms to encourage Ontario's food processing facilities to adopt best management practices and to foster a culture of continuous advancements. The feasibility and benefits associated with implementation of each mechanism are summarized. Many of the mechanisms identified are based on practical experience of the project team in delivering programs and providing services directly to Ontario food processing companies in order to improve their environmental performance through best practice improvements.

Barriers and challenges that typically limit or prevent adoption of best practice environmental improvements by companies are reviewed together with how they can be removed or minimized.

Recommendations are provided on the appropriate procedures that can effectively encourage adoption of best management practices by Ontario food processing facilities. These include the identification and role of key organizations currently providing support services to Ontario food processing facilities to improve their competitiveness and environmental performance. Opportunities for organizational partnerships and linkages that can be developed for a more coordinated delivery are outlined.

Finally, this module provides a series of general, and sector specific Best Management Practices (BMPs) to assist food processing facility managers in highlighting common ideas and themes to apply to their own facilities with the ultimate goal of reducing the costs and environmental impacts from the generation of waste and wastewater effluent.

Barriers to Adoption of Best Management Practices

This section of the manual provides a summary of the barriers and challenges typically faced by food companies in adopting new technologies and best management practices. An understanding of these barriers is necessary in order to identify appropriate mechanisms to address them and to encourage and create a continuous improvement culture in food company operations. As an important element to the success of implementing water/waste minimization and pollution prevention projects, the opportunities and barriers to adopting new technology and new ways of thinking are explored. The result of this analysis can have a positive influence on motivating behaviour change of food companies and can be used to influence government policy and assist in the design of private and public sector program initiative to address these barriers.

The Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) has developed working definitions to categorize food companies based on annual sales and number of employees. Small companies are defined as having annual sales of less than $10 million and between 10 and 50 employees; medium-sized companies have annual sales between $10 and $200 million and between 50 and 100 employees; and large food companies have annual sales of more than $200 million and more than 100 employees.

The level and extent of barriers facing food companies varies and depends on their size, location, sector, and organizational and management structure. For the purposes of this module, the goal was to identify a broad set of common challenges faced by Ontario food and beverage processors, and to make recommendations on mechanisms that can address them.

Several studies have analyzed the barriers that limit or prevent companies from adopting best practices to improve their environmental performance. Barriers can be faced by any company regardless of size, but tend to be more prevalent in small and medium sized (SME) companies since they typically lack the human, financial and technical resources to identify and implement best practice improvements.

In simplest terms, lack of awareness, time, expertise, money, and access to an information and training support network, are common barriers faced by food companies. These barriers are discussed in further detail below.

Barrier: ***Lack of Awareness and Understanding***

Many food companies lack awareness on the tangible economic and environmental benefits that can be realized from best practice improvements. They do not generally view best practice environmental improvements as a strategic business opportunity that can increase profit margins and reduce liability and risk. Some companies perceive they are too small to realize economic benefits, and that cost-saving opportunities are only available for larger companies. They also lack the understanding of the compelling business case of best practices and how adoption of such practices can provide a competitive advantage.

Barrier: ***Lack of Time and Human Resources***

Food processing companies have limited time to consider best practice and operational efficiency improvements in their operations. Senior management focus is on short-term business survival or growth. Human resources are limited and plant engineering focus and priority is on production. Medium to longer-term focus such as best practice environmental improvements are a secondary priority, particularly if senior management lacks awareness and understanding on the economic benefits.

Barrier: ***Lack of Technical Knowledge and Expertise***

In some cases, food companies lack knowledge and know-how to identify and implement best practice improvements. In other cases, they may know where opportunities exist, but lack the technical expertise to conduct a more detailed evaluation to identify, prioritize and implement. The ideal technical mix is the knowledge of the food manufacturing process and the know-how required to identify and implement best management practices. This mix of expertise is generally available in larger food companies but typically is lacking in many SME food and beverage companies.

Barrier: ***Lack of Financial Resources***

Many food processing companies have difficulty in accessing internal financing and capital to study and implement best practice projects. Capital is limited and is usually prioritized to production, facility expansion and marketing. There is also difficulty in achieving acceptable corporate return on investment (ROI) and payback criteria for best practice projects. Smaller food companies can struggle with cash flow issues and business survival, and can view investments in environmental best practices as a low priority discretionary cost.

For food and beverage companies that are well managed and have an appropriate level of cash flow that would allow for investment in best practice improvements, the senior financial decision-maker may be unaware or unwilling to prioritize capital for such projects. There is a gap between plant management and finance that limits support of investment to improve environmental performance.

Barrier: ***Lack of Relevant Information and Support Network***

Many food companies lack relevant information on the financial and operational benefits of implementing best practice improvements. They require practical food case study examples that quantify these benefits and the technical assistance necessary to help apply them to their specific operation.

Other food processing companies, especially the smaller ones, lack a mentoring and support network that can provide assistance in the form of counseling, training workshops and seminars. They generally do not have the time or financial resources to join and actively participate in industry and professional associations, or to attend conferences and tradeshows.

Solutions to Overcome Barriers

The main barriers discussed in this section were developed from studies and surveys of food and beverage processing companies conducted by project team members, and the project team's experience in delivering programs and providing services to encourage adoption of best practices by this industry in Ontario.

The barriers identified are common across different sectors of the food industry and a wide range of companies regardless of their size or ownership. There is some degree of overlap between the barriers, but there is consistency across environmental issues such as water, wastewater management, energy, and pollution prevention.

The solutions are offered as products and services delivered from trusted sources such as the Alliance of Food Processors and other like organizations. In addition, OMAFRA along with other interested Ontario Ministries, have a vested interest in a healthy food and beverage industry and support its development. Solutions will only be successful when the policies of government agencies and industry needs are aligned. However, success will be the sole responsibility of the individual companies implementing change.

Offer a Vision
Food processors need to view water conservation as a strategic business opportunity. To encourage implementation, the issue needs to be repositioned and reframed to show water as a strategic resource for the individual plant and to demonstrate the business case and economic value in minimizing consumption and/or implementing reuse and recycling measures. Implementation programs must have a financial payback to attract the food and beverage industry.

Finding the Time - *Integration of Human Resources*
A food company's human resources are limited and plant operations tend to focus on production and "getting product out the door", with environmental performance improvements possibly being viewed as a secondary priority. However, if the economics are proven, there are ways to implement the changes. Organize a 'team' of staff who have parts of the responsibility and have one champion who can organize and coordinate the activities between the 'team' members. If the assigned activities are consistent with their job functions, it becomes part of their normal workload and not an extra imposition. If the economic potential is confirmed, 'team' members will buy-in. This buy-in is contingent upon:

- Communication of the connection between corporate economic potential and reduced personal financial risk,
- Corporate economic gains and personal economic rewards or incentives.

Using existing management systems for reporting to targets will allow a water/waste conservation program to be integrated into existing production reporting mechanisms.

Technical Knowledge and Expertise – *Get the Resources*
In the area of water conservation, the technical expertise and engineering resources are limited in many food industry plants. Plant personal may know where potential opportunities exist, but they do not have the technical expertise to evaluate the opportunity. As well, some opportunities are integrated, requiring outside technical resources to effectively evaluate.

Solutions, other than management believing an opportunity exists and is willing to fund a feasibility study, are integrated with Ontario Government or AOFP funding programs. Although there are no direct funding programs at this time, new government programs are always considered if they will show an attractive benefit for the industry.

Financial Prioritization – *Expand the Box*
Many food processing companies have difficulty accessing internal financing and capital for water conservation and BMP projects. As with any resource components, such as energy efficiency, conservation of utility costs is not recognized by financial controllers to be as important as production savings. Integrating external costs, such as compliance, extra municipal costs, extra costs to comply with new environmental directives etc. need to be part of the financial analysis. Sometimes these costs are not as defined as direct costs, but they should be considered.

Rather than considering water conservation and BMP projects as special items, they should be viewed or integrated into production related projects. In preparing the capital appropriation for good projects, plant and engineering management need to understand and present the payback parameters. The cost of water consumption and wastewater treatment can be significant but may sometimes be ignored as a cost of the business. As these costs rise, the cost to the company increases. All of these parameters need to be presented as part of the payback analysis for any project. Finally, when considering production improvement projects, the integration of water conservation savings can be added to the payback analysis to provide an extra incentive for the project.

In requesting capital for good projects, the presentation should be consistent with other projects presented to the corporate financial decision makers. A strong business case is required including a strong ROI and payback analysis. The financial professionals need to be able to compare the merits of these projects on a common ground with other production or operations based projects.

Lack of Information – *Offer a Support Network*
Because food processing companies are very focused on the daily production activities, they need relevant information on the financial and operational benefits of implementing best practice improvements. In addition, a support network, such as the Alliance of Ontario Food Processors, is beneficial to generate and distribute the ideas as well as provide mentoring. Successful delivery of these services can help provide a 'vision' to food companies to help them develop programs that are their own.

The key to a successful program will be one that allows the food processor to access resources and mentors at their own speed. The resources should be cumulative, allowing the company to build a program at their speed. As companies participate and are successful in developing programs,

others will follow by example. Note: this will only work if the information is available and accessible.

Opportunities and Barriers to Adopting New Technology

The adoption of new, innovative technologies is an important focus within a culture of continuous improvement. By identifying, evaluating, and implementing new technologies, food and beverage processors can take advantage of new opportunities to increase efficiency, reduce waste, and become more competitive. However, many companies miss out on these opportunities because of barriers or risks associated with the adoption of new technologies.

A number of studies have identified barriers the small- and medium-sized enterprises typically face when implementing new technologies. Understanding these barriers, and the solutions to overcome them, is essential for companies looking to continuously improve their operations.

Barrier: ***Lack of Availability and Integration of Financial Resources***

Many food companies have difficulty accessing internal financing and capital to evaluate and implement new technologies. Companies may focus on short-term capital costs as opposed to longer-term operational savings associated with new technologies. Long investment periods for equipment may hinder the replacement of traditional technologies with newer, more sustainable, technologies.

Barrier: ***Lack of Willingness to Accept Technical Risk***

Many food companies feel that the adoption of new technologies carries an inherent risk and prefer to invest in existing technologies that are proven to work. These may include technical risks that could disrupt existing processes and risks related to whether or not the technology will meet the expected level of performance. Opportunities and benefits associated with the implementation of new technologies may be missed because companies have a low tolerance for risk.

Barrier: ***Lack of Technical Knowledge and Expertise***

The identification, evaluation, integration and maintenance of new technologies require a level of specialized knowledge and expertise that may not be present in many food companies. Plant managers may have to evaluate technologies without much of the information available for traditional technologies. Installation and maintenance of new technologies may require specialized training or outside expertise that may present an additional burden to companies.

Barrier: ***Lack of Willingness to Participate as an Early Adopter***

Companies that have developed new technologies often rely on customers who are willing to work with the supplier to develop technologies that better suit user needs. In addition to this continuous feedback,

these customers are often used as references and case studies on which future customers will rely on to make purchases. Many food processors do not have the resources or willingness to provide this level of engagement with the technology developer.

Solutions to Overcome Barriers

The barriers identified in this section were developed from studies and the project team's experience in the creation of markets for new technologies.

These general barriers are common across different sectors and overlap many of the barriers to the implementation of best practices identified earlier. These barriers contribute to missed opportunities to improve the competitiveness of Ontario's food and beverage sector. By addressing these barriers, the Ontario food industry will become more sustainable and create markets that will drive the growth of innovative clean technology companies within the Province.

The solutions to these barriers require the coordinated efforts of all stakeholders and may be offered as services delivered through trusted sources such as the Alliance of Ontario Food Processors, with support from provincial Ministries. Just as with the implementation of best practices, success will ultimately be the responsibility of individual companies who adopt new technologies.

Financial Prioritization – *Focus on Lifecycle Costs*

Many food processing companies do not fully integrate the assessment of capital and operational costs. New technologies may have a higher capital cost, but can offer significant savings on materials, utilities, compliance, maintenance and other costs. Companies should consider all direct and indirect costs when making decisions on capital expenditures. Many of the recommended solutions for Financial Prioritization for Best Management Practices are also applicable to the adoption of new technologies. Companies should also anticipate the need to upgrade or replace existing equipment with long investment cycles in order to gather information that can be used to make a business case for new technologies when they are needed.

Technical Risk – *Assess and Manage Risks*

The adoption of new technologies involves an inherent level of risk above that associated with existing, proven, technologies. This risk can be partially mitigated through due diligence evaluation of the technology provider's capacity. While new technologies may not have many reference installations, companies can improve their level of confidence by investigating existing installations and referring to any independent third-party evaluations of the technology that may have been conducted. In some cases, industry stakeholders can work with a verification program, such as Environmental Technology Verification Canada, to develop performance benchmark criteria for the evaluation of new technologies.

Companies should also manage their expectations of new technologies. In some cases, the performance of the technology may still have to be optimized, resulting in lower initial performance or potentially some delays. If a company is not prepared to accept those risks, they may considered whether or not it is possible to install the technology in a limited capacity at first, and then expand to a plant-wide installation once the performance has been proven.

Companies should also investigate the possibility of mitigating some of the financial risk associated with new technologies through demonstration support programs offered by provincial and federal governments.

Knowledge and Expertise – *Utilize a Support Network*

Many food companies have limited technical expertise in the area of water technologies and may require assistance to identify, evaluate, integrate and maintain new technologies. Companies should take advantage of existing, trusted, organizations that can provide a support network and assist in identifying new technology opportunities. Companies should also discuss technical needs with the technology developer, industry associations, and government representatives to see if there are any options available that may address this lack of expertise.

Early Adoption - *Customers as Partners*

Companies who are early adopters of technologies are often expected to provide information on their technical and economic needs and work with the technology supplier to improve product design, functionality, performance, and pricing. Food companies who act as early adopters can provide extremely valuable feedback to help the technology developer better understand the technical and business needs of the food industry. These early adopters may also serve as reference cases which future customers may rely on to make purchasing decisions. Food processing companies should make sure that their staff is organized and capable of providing the level of feedback and interaction that is expected from early adopters.

There is a need for the government and/or the association to create recognition or incentives as a rationale for early adopters to share their experience with others. Financial incentive programs and/or industry awards can provide extra positive visibility to early adopters, which may help in brand imaging and business development and growth.

Best Management Practices

This section provides a series of general and sector specific Best Management Practices (BMPs) to provide some insight to food processing managers. While many of the BMPs are generic or general, consider how they might be implemented at your facility. The categories include:

- Performance Benchmarks
- No Cost Procedural Changes
- Low Cost Procedural Changes
- Operational and Process Monitoring Opportunities
- Water Reuse or Recycling Opportunities
- Washing, Rinsing, and Cleanup
- Maintenance Procedures and Options
- Controls and Process Automation
- Energy and Water Integration
- Capital Expenditure for Integrated Solutions
- Opportunities in the Brewing Sector
- Opportunities in the Dairy Sector
- Fruit, Vegetable and Starch Processing
- Meat and Poultry Processing

Performance Benchmarks

This is a list of general performance benchmarks to consider before evaluating the other best management practices in context to your facility. These benchmarks can be applied as a first pass opportunity evaluation tool or as a tool to motivate all involved parties to assist in minimizing waste and wastewater effluent.

- Food plants that practice water efficiently discharge 50%-25% of the water they use to sewers.
- A 5/8" hose uses $7.00 worth of water/hour. On a daily (24 hour) basis, this equates to $170;
- It costs as much as $7000 less to run a 3/8" valve for 2000 hours at 60psi than a ½" valve;
- Every $1.00 spent on water and sewer can add $0.40 in associated energy costs;
- Every $1.00 spent on water will add an extra $1.14 to your municipal sewer bill;

- A kilogram of waste costs 10 times more as a sewer surcharge than a kilogram of solid waste sent to landfill;

- Closed loop cooling towers usually have a 4 to 21 month payback period and can reduce water use 10-20 %;

- Install low volume automatic flush faucets, toilets and urinals to save $7.50 to $32.00 per employee per year. For a facility with 100 employees, this could yield a savings from $1000 to $3200 annually;

- Drain off canned ingredients into solid waste containers rather than into sewers if the packing liquid is an unrecoverable input. Solid waste costs 1/10th as much as a sewer surcharge. This practice has helped some food processors reduce their discharge by as much as 1,000 BOD (Biological Oxygen Demand);

- Scrape, shovel, and squeegee prior to wash-down as this reduces BOD and suspended solids in wastewater by as much as 50%;

- Use the Monetary Concessions Programs in Toronto, Peel Region, Guelph, and Waterloo Region. These municipalities will rebate up to 50% of sewer surcharges from the previous 3 years when sewage loads are reduced to by-law limits or by a minimum of 50%. These rebates can be used for capital equipment, engineering and equipment installation;

- Target solid matter content of wastewater as this discharge from food and beverage processing facilities is estimated to emit 15% of all greenhouse gasses for this sector. These emissions are largely emitted as methane from decomposition;

- Reduce total energy use with "free cooling". Water cooling towers have an average simple payback of 14 months.

No Cost Procedural Changes - *Easy to Implement*

No Cost Procedural Changes are the easiest and cheapest opportunity to reduce water, waste, and wastewater discharge to the sewer. These considerations typically do not require any additional capital expenditures. Proper implementation of these changes can have a relatively high impact on the facilities bottom line with no new capital expenditures. Most considerations presented require commitment on the part of staff and management to execute. An awareness and training program will develop an appreciation for executing these changes:

- ❑ Sequential scheduling of products that use the same line or equipment can reduce cleaning requirements;
- ❑ Maximize the dedication of process equipment. This can reduce equipment cleaning frequency and waste generation;
- ❑ Minimize the loss of product by minimizing spilling ingredients and product on floors;
- ❑ Use pre-clean and dry cleanup methods before wet cleaning. This prevents adding additional waste to the wastewater stream;
- ❑ Sweep up solid materials for use as by-products (if possible) instead of washing it down the drain;
- ❑ Do not allow water to run continuously unless necessary.

Low Cost Procedural/Facility Changes – *Little Money Goes a Long Way*

The low cost procedural and facility changes to consider are one time, low capital and procedural changes that can have a large impact considering the investment size. Similar to the no cost items, these considerations typically do not require any significant capital expenditures. Proper implementation of these changes can have a relatively high impact on the facility's bottom line. Most considerations presented require commitment on the part of staff and management to execute. Similarly, an awareness and training program will develop an appreciation for executing these changes.

- ❑ Place catch pans under potential overflows/leaks to collect high strength BOD and dispose separately;
- ❑ Use the minimum amount of cleaning agents and detergents necessary to comply with food safety requirements;
- ❑ Cap or cover process drains (where feasible) that connect to the wastewater stream. Cover can be removed as part of the operating procedure for certain equipment or can be used to contain and clean up spills;
- ❑ Fit drains with screens and/or traps to prevent solid materials from entering the effluent system. Ensure screens have a maintenance program;
- ❑ Install screens at strategic locations in the process to prevent solids from entering the wastewater stream;
- ❑ Replace traditional faucets and sanitary fixtures with water conservation fixtures;

- ❑ Install squeeze trigger faucets on all hoses used for cleanup;
- ❑ Install water meters on important and/or high flow locations or processes.

Operational and Process Monitoring Opportunities

BMPs related to operational and process monitoring are important. These considerations are ones that require an action on the part of staff and/or management. This could mean a staff member or manager is required to monitor water consumption on a daily, weekly, or monthly basis followed up by investigation and corrective actions for any upsets. Continued monitoring is the goal of these considerations, and a larger commitment of time and soft capital (training and manpower) is typically required. Continued monitoring of the ideas presented below can significantly impact a facility's waste and wastewater effluent related expenses. Depending on the action, facility personnel can take on these monitoring rolls within their skill sets. Larger facilities might find it advantageous to add capacity to accommodate proper monitoring and management of the ideas of consideration. Some changes and considerations include:

- ❑ Training and awareness for employees on how to use water efficiently;
- ❑ Skim grease traps regularly;
- ❑ Improve maintenance and operational programs to identify process upsets, malfunctions, and problems early in the process to minimize the amount wastewater produced;
- ❑ Monitor liquid fill machines frequently. Respond to overfilling, line blockages, etc. immediately;
- ❑ Review Material Safety Data Sheets (MSDS) and other information provided by manufacturers of chemicals used or purchased to identify products containing non-conventional pollutants. Identify alternative products for any containing those pollutants;
- ❑ Analyze production efficiency by evaluating water consumption using liters of water used per kilogram of product manufactured or liters of water per unit processed;
- ❑ Install water meters in different process areas to monitor consumption and waste generation on an ongoing basis. Use data to identify areas of inconsistent and inefficient water usage, correct deficiencies and set progressively tighter consumption targets.

Water Reuse or Recycling Options - *Minimize Flow*

Options for reusing or recycling water will take a more creative approach tailored to your facility. The ideas presented here may appear general in nature, but require specific application within the plant by understanding water volumes and water quality required for specific tasks. This is where executing the other aspects of your water strategy is important. In many cases, the identification of water recycling opportunities may need some engineering evaluation to implement.

- Reuse process water wherever possible. Often final rinse waters can be relatively clean and available for other functions;
- Eliminate once-through cooling water by implementing closed loop cooling systems;
- Reuse secondary rinse waters where possible, with due regard to product quality implications;
- Consider 'cascading' rinse strategies where the cleanest rinse water is 'cascaded' forward and used as a secondary or primary rinse;
- Separate wastewater streams according to level and type of contamination and investigate the potential for reuse of each stream;
- Where water is used as a transport mechanism, such as a flume, consider secondary recycled water as the medium;
- Recycle caustic used for primary cleaning until spent. Disposal of the waste could be used as a pH neutralization agent for wastewater that is off spec.

Wastewater Reduction Opportunities – *Save Money on the Discharge*

The intent of this section is to reduce the volume and strength of wastes sent to the sewer. The solutions appear to be quite general in nature however, when these solutions are identified and implemented, the impact can be quite large:

- Avoid use of water as a transport medium, especially in terms of flushing materials to drain. Transfer or remove solids and particulate matter by mechanical means such as screens. This can often be relatively in expensive pretreatment;
- Direct clean storm water away from wastewater drains;
- Determine most contaminated effluent stream and divert for separate treatment. Remaining streams may be in compliance and can be discharged with no (or minimal) treatment.

Washing, Rinsing, and Cleaning

Food processing operations usually require extensive washing, rinsing and cleaning of equipment and food product. The volume of water consumed, and the use of various cleaning agents deserves significant attention for most facilities. Some general ideas for consideration are provided below:

- Reuse final rinse from cleaning operations for the initial rinse on the following day;
- Use counter current wash and rinse procedures;
- Eliminate once-through cooling water, by implementing recycling or reuse practices;
- Reuse secondary rinse waters where possible, with due regard to product quality implications.
- Turn off rinse water when not operating;
- Optimize spray nozzle pattern and configuration for the most effective spray rinse using the minimum amount of water;

- ❑ Consider high-pressure spray washers and nozzles for wash down rather than hoses at normal municipal water pressure to save water;
- ❑ Use a spray rinse technique rather than immersing in a bath if the quality of the rinse is not compromised.

Maintenance Procedures and Options

Maintenance practices and facility upkeep can have a significant impact a facilities water use. Certain practices should be encouraged while others discouraged or controlled. Below are some more general maintenance practices that should be considered when executing an analyzing a facilities water use and wastewater generation:

- ❑ Inspect and execute preventative maintenance of potential discharge areas;
- ❑ Maintain tanks, equipment and pipes to prevent leakage;
- ❑ Include nozzle inspection in routine maintenance schedule. Wear of spray nozzles increase the water flow rate;

Controls and Process Automation – *Minimize Staff Interaction*

One of the most important steps and considerations a food processor can take is the addition of controls and process automation. Although these changes often require some level of capital investment, they also can have some of the most significant impact on not only plant output potential but also on profitability by reducing needless wastes, and minimizing water costs. Often process automation considerations occur at the facility with production in mind and without consideration for the impact on water or waste. The following ideas are presented to encourage adoption of BMPs using controls and automation:

- ❑ Centralize the control of the water supplies. This will enable water supply to be shut off during breaks;
- ❑ Install automatic shutoff nozzles/valves on all water supplies when feasible;
- ❑ Install controls, like solenoid valves, to stop water flow when equipment is not in operation and no water is required;
- ❑ Install flow control valves to regulate water flow in sprayers at conveyors with variable speed;
- ❑ Install spray nozzles on hoses and use high pressure rather than high volume for cleaning surfaces;
- ❑ Use automated cleaning-in-place (CIP) where feasible;
- ❑ Critically assess and set CIP rinse cycles to minimum time required to perform a quality cleaning;
- ❑ Install controls, like high-level alarms, to prevent tanks from overflowing.

Energy and Water Integration – *Achieve Double the Savings*

Often energy efficiency gains are coupled with water savings. A facility evaluating detailed energy opportunities should not overlook the potential for avoided purchased and treated water costs associated with various opportunities. An energy savings project that might not standout as a worthwhile investment based on energy savings alone, but when coupled with the related water savings could make an attractive investment for a facility. Below are some general best management practices to consider when developing joint energy and water efficiency projects for your site:

- ❑ Recover as much condensate as possible. Hot condensate water to the drain consumes water and loses the energy spent to heat the water to steam;
- ❑ Changing from manual blow-down control to automatic adjustment can reduce a boiler's energy use by 2% to 3% and reduce blowdown water losses by up to 20%. Install automatic boiler blowdown using conductivity;
- ❑ Pretreat boiler water with RO membranes to extend the life of the water and reduce need to blow down;
- ❑ Optimize pump impellers to ensure the duty point is within the optimum zone on the pump curve;
- ❑ Hot water from cooking kettles, especially those that are jacketed, should be recovered and reused rather than discharged as effluent. This practice saves energy and water;
- ❑ Any time hot water is discharged to the drain, consider heat recovery from the hot water and reuse of the energy.

Capital Expenditure for Integrated Solutions

Integrated solutions requiring capital expenditure are usually custom designed to the facility. They can often involve new equipment upgrades, controls based solutions, and even additions to the facility. These high investment opportunities contain the highest savings potential but also the highest upfront costs. These costs are often viewed as a barrier to implementation of the project. These projects still deserve consideration, especially if it improves the competitive position of the business. With sound project cost and savings evaluations, strong consideration should be given to implement these projects. Below are some commonly applied capital expenditure best management practices that have shown success in facilities in the Ontario region:

- ❑ Replace water based conveyors with mechanical conveyors;
- ❑ Install a 'pigging' system to clean lines with highly viscous product such as process foods, jams, syrups, fruits etc. rather than using water to push through. Recover viscous material as solid waste;
- ❑ Substitute air-cooled Air Conditioning units for water-cooled units;

- ❑ Rather than using once through seal water for liquid ring vacuum pumps, recycle cooling water. Seal water can be recycled 50% with little investment. Seal water can be recycled 100% with an investment in heat exchange;
- ❑ Replace once through water-cooled compressors with a chiller or with air-cooled compressors.

Opportunities in Brewing

- ❑ Defrost cold radiators in conditioning tank rooms with electricity instead of water sprays;
- ❑ Carbon Dioxide recovery can result in a 30% reduction in water and sewer charges and a 10% reduction in electrical costs;
- ❑ Distilling wastes for ethanol recovery as salable alternative or co-products prior to waste treatment can increase revenues, as well as reduce waste related costs and volumes;
- ❑ Remove grain from laudertun with dry methods, like raking or brushing;
- ❑ Clean laudertun, copper, and whirlpool with wash water from other cleaning operations, but ensure that hygienic conditions are not compromised;
- ❑ Increase the lifetime of the cleaning caustic by collecting it in an insulated settling tank and reuse it in bottle washing after removal of the sediment;
- ❑ Use the bottle rinse water for crate washing;
- ❑ Reuse the seal water from liquid ring vacuum pumps, for example in bottle washing process;
- ❑ Adjust tank-washing cycles to reduce the water and detergent usage according to the size of the tank.

Opportunities in Dairy

- ❑ Ensure accurate temperature control of plate, tubular and surface coolers to prevent freeze-on, which may result in loss of product;
- ❑ Install suitable liquid level controls with automatic pump stop, alarms and other control mechanisms at equipment where overflow can occur, e.g. storage tanks, processing tanks;
- ❑ Ensure cheese vats, vat processors, cooling tanks and other mixing tanks are filled to level that will not cause spillage during agitation;
- ❑ Use airtight separators, proper seals on pumps and proper line connections to prevent inflow of air when lines are under partial vacuum;
- ❑ Reuse water from reverse osmosis process, which is used to concentrate whey, for example to wash equipment or purge lines.

Fruit, Vegetable, and Starch Processing

- ❑ Use dry peeling methods;
- ❑ "Heat and Hold" blanching provides superior quality and consumes less energy and water compared to traditional blanching techniques;
- ❑ Starch recovery (ie. by cyclones or centrifuge) prior to waste treatment can reduce both total suspended solids and Biological Oxygen Demand in wastes.

Meat and Poultry Processing

- ❑ Maximize the segregation of blood and water by designing suitable blood collection facilities that will ensure blood is directed to the blood collection facility. Bleed animals only once they are above blood collection facility and allow sufficient time for bleeding, generally more than 7 minutes;
- ❑ Replace single-skinned knife sterilizers with more water efficient sterilizers, e.g. water jacket sterilizer;
- ❑ Use of air chillers for carcass cooling in poultry plants to reduce water use by up to 2 liters per bird. This also reduces the incidence of coliform on the product and in the wastewater streams;
- ❑ Use automated operated scalding chambers rather than scalding tanks for de-hairing;
- ❑ Install automated control with sensors to supply wash spray water to viscera section only when required;
- ❑ Set and maintain minimum water flow rates for viscera table wash sprays;
- ❑ Use automated control systems to operate flow of water at knife sterilization and hand-wash stations;
- ❑ Install on/off controls for cooling water on breaking saws. This will ensure water is only supplied when the saw is operated.
- ❑ Use water sprays with pressure of less than 10 bar for carcass washing to avoid removing fat from the surface;
- ❑ Aim to use water with temperatures below 30°C in carcass washing to reduce fat removal from surface;
- ❑ Use automated sensor control to regulate water supply for carcass washing;
- ❑ Boiler condensate that is not returned to the boiler can be used as make-up water for the scalding process;
- ❑ Use dry dumping techniques for processing of cattle paunches and pig stomachs instead of wet dumping techniques;
- ❑ Reuse relative clean wastewater from cooling systems for washing livestock if possible;

- ❑ Reuse wastewater from slaughter floor, washbasins, knife and implement sterilizers and carcass washing for gut cutting and washing. Water may require screening to remove gross solids prior to reuse;
- ❑ Reuse final rinse water from paunch and casings washing for other non-critical cleaning steps in the casings department;
- ❑ Reuse cooling water from the singeing process for other purposes in the pig de-hairing area.
- ❑ Separate high strength effluent streams, such as rendering effluent and wastewater from paunch washing and treat them separately;
- ❑ Use water sprays on splitting saws to remove bone dust and reduce the water required for carcass washing.

Resources

Regulatory

Nutrient Management Act, 2002: O.Reg. 267/03, General; as amended by O.Reg. 338/09; new regulation for non agricultural source material (NASM) handling.

Ontario Water Resources Act: O.Reg. 387/04, Water Taking; relates to Permits to Take Water, allows the Director to consider issues relating to the use of water including water conservation (Sec. 4(2)3i).

Ontario Water Resources Act: O.Reg. 450/07, Charges for Industrial and Commercial Water Users; relates to provincially applied charges for water use in specific sectors including bottled water, beverage manufacturing and fruit and vegetable canning and pickling (where water is incorporated into the product).

Clean Water Act, 2006: O.Reg. 284/07, Source Protection Areas and Regions; relates to prohibitions on activities to protect drinking water sources.
https://www.ontario.ca/laws/statute/06c22#BK60

Safe Drinking Water Act, 2002: O.Reg. 169/03, Ontario Drinking Water Quality Standards.

Funding

Agricultural Adaptation Council: umbrella organization of Ontario agri-businesses to access government funding. AOFP is a member. http://www.adaptcouncil.org

Ontario Ministry of Economic Development. Two programs of note are available: the Eastern Ontario Development Fund (specific to eastern Ontario) and the Advanced Manufacturing Investment Strategy. The latter has criteria specifically referring to projects in waste reduction or energy conservation.

Ontario Ministry of Food Agriculture and Rural Affairs: OMAFRA has developed a web page listing various sources (30) of funding for agri-businesses. Web site is
http://www.omafra.gov.on.ca/english/food/industry/funding-prog-index.htm

Agriculture and Agri-Food Canada (federal gov't): Two programs of note; the Agricultural Flexibility Fund and the ecoAgriculture Biofuels Capital Initiative; both programs are noted in a listing of programs from the Agricultural Adaptation Council noted above.

Waste Conservation and Pollution Prevention

Environment Canada: provides links within Environment Canada for pollution prevention. Access web site at http://www.ec.gc.ca , scroll down to topics, select pollution and waste, then select pollution prevention.

Ontario Ministry of Environment: Ontario Drinking Water Stewardship Program: Pollution Prevention Reviews. Grants (100% of eligible costs) for conducting Pollution Prevention Surveys of sites near municipal drinking water sources. Contact C2P2 for application forms.
http://www.abca.on.ca/page.php?page=drinking-water-stewardship

City of Toronto: Toronto water provides for Pollution Prevention in its Sewer Use Bylaw. Web site is
http://www.toronto.ca/water/protecting_quality/pollution_prevention/index.htm

Technology

United States Environmental Protection Agency (USEPA): Office of Water Management; web site that contains links to various wastewater technology fact sheets. Web site is
https://www.epa.gov/aboutepa/about-office-water#wastewater

Waste Reduction Resource Center (U.S.): a collaboration of the USEPA Region V and the North Carolina Division of Pollution Prevention and Environmental Assistance. Best References: Food Processing (Fruits and Vegetables) provides fact sheets, articles and reports and manuals. Web site is
http://wrrc.p2pays.org/industry/industryinfo.asp?INDSECT=39

Waste Reduction Resource Center (U.S.): a collaboration of the USEPA Region V and the North Carolina Division of Pollution Prevention and Environmental Assistance. Best References: Food Processing (Dairy) provides fact sheets, articles and reports and manuals. Web site is
http://wrrc.p2pays.org/industry/industryinfo.asp?INDSECT=36

Waste Reduction Resource Center (U.S.): a collaboration of the USEPA Region V and the North Carolina Division of Pollution Prevention and Environmental Assistance. Best References: Food Processing (Poultry and Eggs) provides fact sheets, articles and reports and manuals. Web site is
http://wrrc.p2pays.org/industry/industryinfo.asp?INDSECT=51