



EMBRACING SUSTAINABILITY: WATER RECYCLING IN FOOD PROCESSING





WATER, WATER EVERYWHERE...

We live in a world defined by water. 71% of the globe is covered in water, but out of all the water in the world, only 3% is freshwater. Few are more cognizant of water's importance than those who work in the food processing industry, which is routinely recognized for its acute water-reliance. According to the USDA, the United States food system consumes 1/3 of the nation's fresh water. In part this reliance springs from the sheer variety of water's applications across the industry. Water may be used for sanitation, peeling, sorting, heating, cooling and transportation all within a single plant processing a single food product. When one considers both the variety and necessity of these applications, it comes as no surprise that optimizing water usage is a persisting and necessary point of interest to industry professionals. However, in recent years this interest has given way to mounting concern in the wake of intensifying water scarcity.

Water scarcity can be a fluid concept which changes depending on context, but the issue of scarcity as it impacts the food processing industry is one of simple quantity. Fresh water is a finite natural resource which is rapidly dwindling due to societal and environmental factors. In the United States, population growth alongside urban and suburban development has increased consumer demand for fresh water. This increased demand comes at a time when the effects of climate change are causing deviations in regional weather patterns. Climate change has been shown to exacerbate water scarcity in drier regions and environmental experts anticipate scarcity will spread. While it is commonly mistaken for a regional problem,

water scarcity has far-reaching effects. The United Nations describes water-stressed areas as any region which consumes more than 25% of its renewable freshwater resources; researchers estimate that 50-65% of the global population will reside in one such water-stressed area by 2025. Industrial water supply has always been regulated by regional water availability as mediated by domestic demand, but the recent pressures presented above are jeopardizing operations of food processors and manufacturers across the industry.

All food processors rely on water, but the quantity and application can vary, as does the composition and treatment needs of a processor's wastewater. Those who have operated within historically water-stressed areas are already familiar with the burdens of water scarcity, but food processors in soon-to-be formerly water-rich regions may find themselves ill equipped to cope with the steep regulatory and financial challenges of operating in their new environment. Although each of these classifications contains extensive subcategories with unique demands and challenges, the food processing industry can be generally grouped into three categories: Produce, Meat and Beverages (including dairy). The following sections of this paper will outline the water and wastewater needs of each major sector before addressing challenges within current operational and mechanical practices. Sections will also detail precisely how the respective industry sectors can benefit from the implementation of innovative, customizable water reuse technologies.

PRODUCE & WATER REUSE

Fruits and vegetables are an essential part of any diet, but that which consumers consider to be farm-fresh, often undergoes water-intensive processing before it reaches the public's plates. Once harvested, processing typically begins with large quantities of water used for cleaning and product grading, i.e., sorting ripe from unripe or rotten food items. Water is also commonly

used to provide a gentler means of transportation as produce's value and shelf life can change dramatically based on bruising or other physical imperfections. Because this sector revolves around seasonality, additional water is required for preserving harvests through canning or freezing. Between cleaning, boiling, blanching and other processing techniques,



water usage adds up quickly before additional applications like plant sanitation are factored in.

Produce processing yields a wide variety of byproducts which change from crop to crop. Elements like residual soil, oils, biodegradable carbohydrates and solids from trimming or peeling are just a few of the organic materials common within this sector's wastewater. Wastewater streams can also include residual pesticides, added cleaning agents, chemical oxygen demand (COD) and biological oxygen demand (BOD). Resulting effluent can consist of any combination of these factors, which requires custom pretreatment before it can be safely discharged to the environment or local treatment works. Common physical treatment strategies include skimming, filtering, oscillating screens or flotation separation for waste streams with a high quantity of particulate matter. Biological processes such as aerobic and anaerobic processing relies on microorganisms for breaking down smaller organic matter. These processes are often utilized as simple pretreatment measures. When the end goal is discharging rather than reuse, effluent end-quality often reflects this; even though failure to meet strict regulatory standards can incur high fines.

Implementation of a high-quality wastewater treatment system opens the door for water reuse and fewer occasions of effluent-exceedance fines on top of routine charges. Of the applications described above, only water used for sanitization (known as general purpose water) and the water which comes into direct contact with the food product (known as process water) must be potable. Yet, potability is not a prerequisite for every application within food processing. Much of a facility's wastewater can be easily treated and reused for various non-potable applications. With the addition of Kemco Systems' patented KLEENWATER system, a produce processing facility could efficiently filter both particulate and dissolved contaminants without waiting for gravity or microorganisms. With the KLEENWATER system, plants can turn discarded water from the cleaning process into water suitable for canning or cooling pre-sealed packages of food. Not only would this lower the volume of a facility's incoming freshwater and outgoing wastewater but the KLEENWATER system is also able to maintain thermal energy, benefitting an operation through energy conservation.

RECYCLING WATER IN MEAT PROCESSING

While food products in the meat sector may be less dependent on seasonal shifts, their demand for water is in no way diminished. Beef, poultry and pork industries have been at the center of water sustainability discussions for years, and the rising popularity of meat alternatives proves that consumers are concerned with sustainability in this sector. In order to produce a single pound of poultry, an estimated 257 gallons of water are required. This number jumps to 545 gallons per pound of pork and 1,675 gallons for a single pound of beef. Some of this water use is unavoidable, but processors may make their water stretch further in other areas of production and processing. Water is commonly used within meat processing for equipment and product cleaning, thermal pasteurization, freezing, scalding, chilling and the transportation of waste like fat, feathers and scraps.

Meat byproducts are commonly reclaimed for use in

products such as pet food, but their wastewater remains highly contaminated and requires extensive treatment. Common waste stream pollutants include BOD, nitrogen, proteins, copious fats, oils and grease (FOGs) as well as other suspended solids. To effectively remove these byproducts and purify the water before facility discharge, meat processing wastewater often requires extensive, multi-step treatment. This can be accomplished with systems such as rotary drums, which can separate liquid waste from solid waste. However, rotary drums are highly susceptible to mechanical failures which can stop processing in its tracks. Because raw meat products are highly perishable, extended delays in production may result in significant loss of product that cuts into the bottom line.

Much like produce processing, certain applications of water within meat production do not require wastewater be treated to the point of restored



potability. Still, regardless of application wastewater must be cleansed of potentially harmful bacteria. While Kemco's KLEENWATER system is comprised primarily of ceramic membrane filtration working in tandem with a reverse osmosis system, it is compatible with other

Kemco systems for pre-treatment or polishing integration. Specifically, for meat products requiring extensive processing, this could include installation of Kemco Systems' Dissolved Air Flotation system.

BEVERAGE PRODUCTION & WASTEWATER REDUCTION

The diversity of products across the beverage sector is difficult to overstate. Ranging from juices, to dairy, to sodas, across the wide-sweeping spectrums of alcoholic drinks and even different kinds of water and beyond. The variety within the beverage industry is reflected by different producers' demands for water either as an ingredient, a processing medium or both. Outside of its use as an ingredient, water is used to chill products, disinfect bottles, sterilize equipment and clean facilities. The dairy sector is unique in food processing as very little milk byproducts are left unused. Products like whey and cream are valuable in their own respect and are separated accordingly. Unlike the rest of the beverage industry most water usage in dairy is attributed to sanitation applications, whether that be cleansing processing equipment or the raw dairy itself. This can include pasteurization and homogenization processes, but byproducts used in further food production like the cream inside ice-cream or whey within cheese require additional unique water applications.

In recent years, beverage giants like Nestlé and PepsiCo have invested millions to reduce their facilities' water consumption rates in the face of scarcity and instances

of consumer criticism. An essential part of this investment in sustainability has involved implementing technologies which allow facilities to repurpose their wastewater for non-ingredient applications. Researchers have specifically recommended beverage processing facilities integrate reverse osmosis treatment systems to render wastewater suitable for sanitation purposes.

Water's role in sanitation is intrinsically linked to its temperature; when bacteria is properly exposed to hot water it can be effectively destroyed without the need for costly or harmful chemicals. Because of this, the KLEENWATER system is ideal for integration into beverage processing facilities. Not only does it utilize the recommended reverse osmosis technology as a final step but the KLEENWATER system is able to maintain thermal energy as wastewater is filtered via ceramic membrane filtration, which yields immediate energy returns. Facilities are lightening their energy load and reducing greenhouse gas emissions when utilizing the KLEENWATER system because they do not need to heat and reheat resultant water. As no heat is lost during the treatment process, less heat is required to return the water to a temperature suitable for plant sanitation.

KEMCO'S PATENTED KLEENWATER SYSTEM

The challenges facing food and beverage processing professionals are clear. Present solutions employed across these various industrial sectors fail to consistently meet an operator's needs for efficient, high-quality wastewater treatment that will bring them closer to their sustainability goals. Kemco Systems has emerged as a forerunner of food processing innovation thanks to their patented KLEENWATER system. The KLEENWATER system has been recognized for combining two treatment

processes, ceramic membrane filtration (CMF) and reverse osmosis (RO), in a way that retains thermal energy and delivers a near-potable quality of water.

While membrane filtration is not new, some more fragile membrane types are susceptible to buildup and failure, requiring considerable chemical treatment and maintenance. These ceramic membranes have proven superior and avoid these pitfalls thanks to their durability and



thermal stability. During the ceramic membrane filtration process, the wastewater is filtered using ceramic elements with a porosity of less than .05 micron to deliver a reusable quality. This highly efficient, chemical-free process removes an impressive percentage of wastewater contaminants resulting in a filtrate free of oils, greases, suspended solids, viruses, bacteria and microplastics. After passing through KLEENWATER's CMF elements, the filtered water undergoes a high-temperature reverse osmosis process and any rejected contaminants are removed for disposal via concentrate stream.

Kemco's KLEENWATER system uses purpose-built reverse osmosis (RO) membranes to remove remaining

dissolved constituents, color and PFAS from the CMF filtrate. Kemco's RO water treatment systems consistently measure at less than 300 PPM TDS, often registering less than 100 PPM. Because RO is a physical process it also aids in the reduction of a facility's chemical costs, making for an eco-friendly operation. Together, the RO and CMF which make up the KLEENWATER system consistently yields water reuse rates of 75–85% while retaining thermal energy. KLEENWATER provides food processors with a proven and reliable avenue to reduce water use, discharge costs and significantly minimize greenhouse gas emissions by lowering a facility's heating load.

THE FUTURE OF FOOD PROCESSING

Average consumers may not be well versed in what water and energy conservation in food processing entails, but this does not mean they are unaware of the issues surrounding the industry. As a society we rightfully hold food processing facilities to high standards. One of the largest hurdles facing the growth of water recycling in food processing is a matter of perception. In the food and beverage processing industry, perceived quality is inextricable from perceptions of sanitation and safety. Both processors and customers alike are acutely cognizant of the product's quality from source to plate, and those who are unfamiliar with food processing and/ or wastewater treatment may assume water reuse carries some health risk to consumers. To effectively overcome this obstacle, food processors should opt for high quality water recycling systems like Kemco Systems' patented KLEENWATER system to support their non-potable needs.

Consumers and processors again find a shared understanding regarding the environmental imperative of water recycling, with recent trends pointing toward broad concerns for sustainability ultimately impacting consumer purchasing habits. One time water use is more than a waste of water; processors practicing these single-use habits minimize the return on their initial investment in the water and squander valuable time and

space within their facility to dispose of something which is still useful. The cost of water is only projected to rise; this in a field already subject to steep fines from receiving publicly owned treatment works (POTWs) when operators fail to meet discharge standards. However, conservation measures like the ones outlined above consistently yield long term cost reductions for operators. Water reuse and recycling yields tangible returns to the bottom line and those returns are expected to compound in the coming years. In addition to financial benefits, progressive operators are making undeniably positive environmental impacts. This can help processing plants meet greater corporate sustainability goals while elevating their company's public profile in an age of mindful consumers.

Kemco has built its business on helping clients drastically reduce their operating costs while improving their environmental footprint and now Kemco Systems is taking the waste out of wastewater by offering food processors systems tailored to their precise needs. Their patented KLEENWATER system not only delivers reliable returns but also enables plant operators to demonstrate their commitment to environmental stewardship. For more information on how Kemco's wastewater recycling systems can help you achieve your efficiency and sustainability goals, contact us today.



ABOUT KEMCO SYSTEMS

Since 1969, Kemco has delivered over 7,000 systems worldwide for industrial water reuse/recycle, wastewater treatment, water heating and recovery and total system monitoring. Kemco systems are built to the highest standards of excellence, for the most challenging conditions and offer exceptional reliability, outstanding quality and top value for its client's energy dollar. Learn more at www.kemcosystems.com or follow us on our social channels, **LinkedIn**, **Twitter** and **Facebook**.

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