

Process Water

Water used by industries and businesses to produce a product or affect a process is known as “process water.” This section discusses the following industries and their uses of process water:

- food and beverages
- auto repair and service
- paper manufacturing
- metal finishing

The chapter will not cover opportunities to save water by using efficient plumbing fixtures and irrigation systems, since these are covered elsewhere in this report.

While much of the information herein is specific to the product being manufactured or service being provided, the potential to design water conservation into the process ranges from simply adjusting the equipment or process to use less water to adopting new practices or processes that use no water at all.

Food-and-Beverage Processing

The food-and-beverage-processing industry includes a wide range of products and manufacturing processes:

- bakery/pastry shops
- industrial bakeries
- breweries
- wineries
- soft drink and juice manufacturers
- dairy-food processors
- meat, fish, and poultry processing
- frozen-food producers
- canneries
- snack-food manufacturers
- grocery stores and restaurants that produce food products for sale
- other food and drink processors

The food-and-beverage industry uses water for many purposes. The quality and purity of the water is of primary concern since it is used to make products that will be consumed. Water is also used to clean and sanitize floors, processing equipment, containers, vessels, and the raw food products prior to their processing. Hot water, steam, cooling, and refrigeration also require source water. Designing and building a facility that has a reduced requirement for water includes:

- designing the facility for ease of cleaning
- providing adequate metering, submetering, and process control
- taking advantage of dry methods for cleanup and transport

Few industrial processes involve no need for water. In every industry that uses water, careful planning and design can minimize water waste and optimize the benefits received from the water that is consumed.

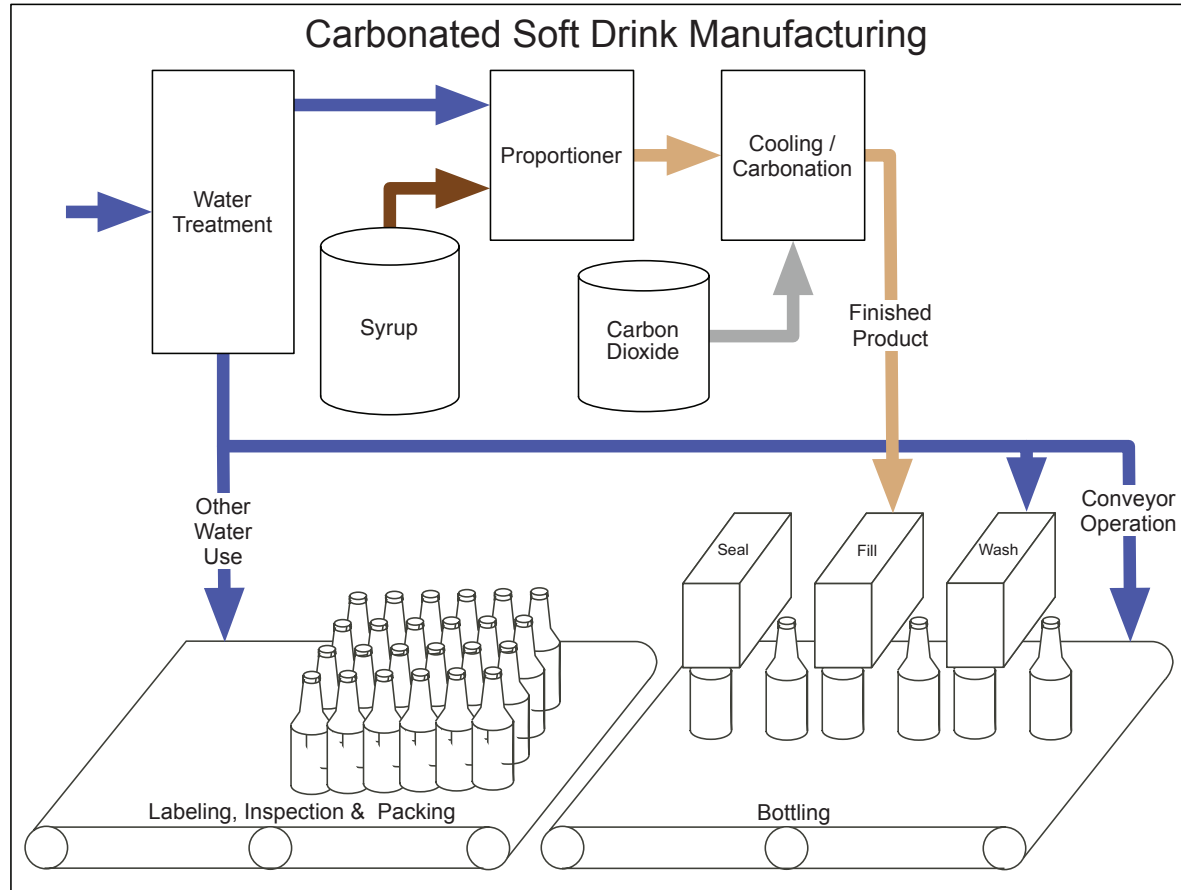
- using product- and byproduct-recovery systems
- incorporating water reuse and recycling
- designing for minimal or no water use

Description of End-Use and Water-Savings Examples

Because of the complicated and highly varied nature of the food and beverage manufacturing industry, providing a simple guide to water efficiency that covers all types of facilities is not possible. Before beginning this discussion of water conservation in food processing, one should remember that health and sanitation are overriding concerns. All actions to reduce water use must be measured against this primary consideration.

The following example illustrates ways water can be used in the soft-drink industry. Potable water is first treated to soften it and, if needed, to remove additional minerals. It is chilled and blended with flavorings and sweeteners, then carbonated. Cans or bottles are filled and sealed, then rinsed and sent through a warming bath to avoid creating condensate in the open air and ensure they are dry before packing. The eight major water-using processes are:

- water softening, which requires periodic filter backwash
- water included in the product
- water to clean and rinse cans
- water to warm cans after processing
- water sprayed on the conveyor line as a lubricant
- water to operate cooling towers for refrigeration equipment and boilers for heat
- water to sanitize and clean the plant and vessels
- water for employee sanitation, irrigation, etc. (North Carolina Department of Environment, Health, and Natural Resources, 1998).



Based upon concise.britannica.com/ebc/art-54000

Each of eight major water-using activities in the food- and beverage-manufacturing sector will be described, along with examples from specific industries where appropriate:

- cleaning and sanitation
- thermodynamic processes
- transportation and cleaning of food products
- equipment cleaning
- container (bottles, cans, cartons, etc.) cleaning
- lubricating can and bottle conveyor belts
- can and bottle warming and cooling
- product ingredients

Cleaning and Sanitation

Information on floor cleaning and the cleaning of outdoor areas is found in all sectors (see “Food Service”). Dry cleanup, preventing spills by controlling processing equipment and leaks, and proper storage and handling of ingredients all reduce water needed for cleaning.

The following table summarizes the importance of water for cleaning in four food-processing sectors (Environmental Technology Best Practices Program).

Water Use by Major Food-Processing Types

Type of Process	Percent of Water for Cleaning
Bakery	70
Soft drink	48
Brewing	45
Jam	22

Thermodynamic Processes

Another common use of water is in the production of steam and hot water and in cooling towers, as discussed in the section on Thermodynamic Processes. Metering and submetering are important in understanding how much water is used in each process or type of equipment. Proper process controls are essential to managing water and energy use.

Transportation and Cleaning of Food Products

The use of flumes to both transport and clean produce (fruits and vegetables) is common. Water is also used in the cleaning and processing of meat, poultry, and fish. Common water-conservation techniques begin with reducing water use by:

- recycling transport water
- adjusting design of flumes to minimize water use
- using flumes with parabolic cross sections
- providing surge tanks to avoid water loss
- using float control valves on makeup lines
- use solenoid valves to shut off water when equipment stops

All these techniques can reduce the need for water, but changing the process has even more potential.

- Replace fluming with conveyor belts, pneumatic systems, or other dry techniques to move food products.
- Install sprays to wash food.
- Use mechanical disks and brushes.
- Install counter-flow washing systems.
- Control sprays on belts.
- Control process equipment to reduce waste.

Grocery stores and smaller bakeries should follow good food-service sector washing practices for meats, fruits, vegetables, and other food products before final packaging. Further, ensure that all water-using process equipment has proper level and flow controls (Costello).

As an example, a Minnesota vegetable-processing firm reduced water use for conveying corn by 20 percent, or 1,000 gpd, just by employing proper controls and recycling 20 percent of the water in the flumes (North Carolina Department of Environment and Natural Resources).

Equipment Cleaning

Equipment to be cleaned ranges from large process facilities and equipment to the hand-held equipment and cooking utensils found in smaller bakeries and grocery stores. Smaller utensils should be washed following the ware-washing considerations found in the “Food Service” section. Larger equipment that cannot be disassembled easily must be cleaned in place. Choices of procedures for cleaning equipment can yield multiple advantages including:

- product recovery
- reduced wastewater loading
- reduced water use
- reduced chemical use

Good design and layout of equipment are essential to easy cleaning.

- Design equipment that minimizes spills, leaks, and residual product that must be removed before cleaning.
- For closed systems such as tanks and piping, eliminate “low spots” so equipment can easily and completely drain.
- Provide easy access to all areas of the equipment that must be cleaned.
- Select materials and surfaces that are easily cleaned.
- Change procedures to reduce the need for cleaning.

As an example, a medium-sized bakery in Minnesota used 65 to 100 buckets a day for storing icing. Washing these buckets required approximately three hours of labor each day, and icing that stuck to the bottom and sides was wasted. They replaced the one-bucket-at-a-time preparation method with a large vat. This reduced the number of containers that had to be washed to three large ones and saved up to \$2,000 a year in icing that was being wasted. It also reduced washing time from three hours a day to a few minutes, thus saving water (Minnesota Technical Assistance Program).

Clean-in-place methods range from flooding the equipment with hot water, detergent, and chemicals, to dry cleaning. Dry cleaning as a first step is essential for saving water, since it reduces the water needed in the wet-cleaning phase, sometimes eliminating it completely. Dry cleaning includes:

- removing as much otherwise-wasted product as possible by pouring and storage for future use
- scraping equipment and vessels to remove as much waste as possible

- using dry brushes, cloths, and paper towels to remove waste
- using wet towels

Dry cleaning can be labor intensive, but the labor costs are offset by the potential to recover product, reduce pollution loading, and potentially clean equipment more thoroughly. It also allows employees to closely examine equipment and discover possible mechanical problems at an early stage.

Where water is used for cleaning, it is important to employ the “multiple aliquots” concept, in which it is better to use a number of smaller volumes of water to clean than one very large volume. For mixers, extrusion and molding equipment, conveyor belts, and other open equipment to which one can gain direct access, cleaning should start with physical removal of residual materials and then be followed by wet washing. Four principles of wet cleaning are:

- use high-pressure, low-volume sprays
- install shutoffs on all cleaning equipment
- use detergents and sanitizing chemicals that are easily removed with minimum water
- install and locate drains and sumps so water and wastes enter quickly to prevent the use of a hose as a broom

For closed vessels, pipes, and delivery tubs, cleaning techniques are very different. They require “Clean in Place” (CIP) and “Sanitize in Place” (SIP) methods. Before cleaning a process piping system, it is essential to remove as much of the product as possible. At its simplest, this involves draining the tank or piping system. Designing the piping to eliminate low spots that can trap product is a major aid in this process. Following this, several methods can be employed to remove extra product and clean the vessel and piping. For piping, three methods find common use, including:

- slug rinsing
- air blowing
- “pigging”

Pigging is a process in which a flexible rubber or plastic projectile is forced through a pipe to push the product out. In Europe a technique using “ice pigging” has recently been developed that uses ice slurry. The pig is forced through the pipe with air, water, or cleaning fluids. CIP systems can also be designed to reuse water and chemicals, if product safety allows.

For vessels, a ball that sprays water in all directions has historically been employed for washing. Replacing that with a high-pressure, low-volume rotating spray that washes product down the sides can reduce the amount of water needed. In many cases, this dilute first rinse can be captured and product recovered. In the dairy industry, pasteurization tanks must be filled with hot water after cleaning to pre-pasteurize the vessels. This water is often captured and reused as wash water for other CIP needs, thus saving both water and energy, since the water is already hot.

Vessel-, barrel-, and cask-cleaning water can also be used for irrigation in the winery industry and, to some extent, in the brewing and vegetable- and fruit-processing industries. The use of this water for irrigation also removes solids and BOD from the waste stream and places it where it becomes an asset to growing plant material.

Container (Bottles, Cans, Cartons, etc.) Cleaning

Cleaning bottles, cans, and containers prior to filling is common throughout the industry. For returnable bottles, the use of air bursts to remove loose debris and materials and the reuse of water from can

warming and other operations are common ways to reduce water use. Other methods include use of pressure sprays and steam instead of high-volumes of hot water to clean containers.

One brewery recovered the bottle wash water and used it for washing the crates in which the bottles are placed. This saved more than 4,500 gallons of water a day (Hagler).

Cleaning cans, bottles, and containers after they have been filled offers other opportunities. Some spillage and overfilling is inevitable, but with proper equipment control this can be minimized. Reducing water use to a minimum and passing the wash water through nanofiltration can recover both the sugars and product for use as animal feed or for growing yeast, while the water is cleaned and made available for additional reuse.

Lubricating Can and Bottle Conveyor Belts

One of the most unusual uses of water in the food and beverage industry is as a lubricant for conveyor belts that move cans and bottles, so they can “slip” easily on the high-speed conveyor belts and not tip over. This water is softened and mixed with biocides and soaps before it is sprayed onto the conveyors. Many attempts have been made to use dry lubrication systems or find other ways to move the cans and bottles at the high speeds needed in modern operations, but the use of water as a lubricant remains the standard for this industry. Many have been able to reduce water use or even capture and recover belt lubricant water. In Australia, eight Cadbury Schweppes plants are testing dry lubricant conveyor systems (Smart Water Fund of Australia). For now, ensuring that the spray nozzles are properly sized, well aligned, and equipped with automatic shutoffs is the best that can be done.

Can and Bottle Warming and Cooling

Water has a variety of applications, ranging from cooling or heating cans to use as a heat-transfer agent. This water remains relatively clean and is an excellent source of water for reuse. Water is used to cool cans after they have been removed from pressure cookers in the canning process. In most cases this water is cooled in a cooling tower or a refrigeration unit that employs a cooling tower in the process. In the warming process, cans and bottles from the beverage industry that have been filled with cold liquids are heated so condensate does not form on them and they dry more quickly before packing. These operations offer significant opportunities for reuse for almost all of the other water needs in the operation, except where potable quality is required by regulation. Examples of reuse include:

- first rinse in the wash cycle
- can and bottle shredder and crusher operations
- filter backwash for product filters
- chemical-mixing water
- defrosting of refrigeration coils
- use for equipment or floor cleaning
- flushing out shipment containers and crates
- cleaning of transport truck and rail cars
- gutter and sewer flushing
- fluming and washing of fruits and vegetables
- makeup water for conveyor lubrication systems
- irrigation
- cooling-tower makeup water

Product Ingredients

Most food products contain water and, in the case of the beverage industry, water is usually a major component of the product. To both reduce water use and loading on wastewater systems requires proper instrumentation and control of filling and packaging operations. The solid waste by-products of brewery, winery, fruit and vegetable processing, and meat processing operations, as examples, can often be used as animal feed or be rendered for other uses. Liquid wastes can also find use in other industries, for example, fruit juice by-product can be used to produce alcohol.

Water-Savings Potential

Examples of practices and water savings are provided above. Because of the varied nature of the products and processes found in the food-and-beverage-processing industry, water-savings potential is slightly different for each. These six design principles will help build water efficiency into a facility:

- design the facility for ease of cleaning
- provide adequate metering, submetering, and process control
- set up the facility to take advantage of dry methods for cleanup and transport
- use product and by-product recovery systems
- incorporate water reuse and recycling
- design for minimal or no water use

Cost-Effectiveness Analysis

Because of the highly varied nature of the food-and-beverage-manufacturing industry, a cost analysis across the industry is not possible. However, several cost areas need to be taken into consideration, including these seven:

- water
- wastewater disposal
- pretreatment
- chemicals for cleaning and sanitizing
- solid waste handling
- energy
- potential to produce a marketable by-product

Recommendations

Proven Practices for Superior Performance

- Require that new facilities provide a list of possible areas of water recovery and reuse.
- Require that all major water-using areas be separately metered.
- Require automatic shutoff and solenoid valves on all hoses and water-using equipment, where applicable.

Additional Practices That Achieve Significant Savings

- Use pigging, air blowing, or slug washing as part of CIP systems for process pipes.
- Use floor cleaning and vacuum machines where possible.
- Minimize the use of water-lubricated conveyor belts.
- Minimize the need to use a hose as a broom by installing drains close to areas where liquid discharges are expected.
- Provide pressure-washing equipment in place of washdown hoses.

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Automotive Services

The automotive service and repair industry is one of the most ubiquitous types of commercial enterprises in any city. Establishments include:

- service stations
- oil change/lubrication
- body repair
- tune-up shops
- full-service repair shops
- fleet maintenance
- tire service

The design of a water-efficient shop depends to some extent upon the type of service offered. New air-quality regulations have also meant that shops have switched from solvent-based parts- and brake-cleaning systems to aqueous-based systems. Floor-cleaning with dry methods, preventing spills and leaks from entering the wastewater discharge system, and the proper design of oil separators have as much



Aqueous Parts Washer

fastt.navsea.navy.daps.dla.mil/frames/rec_4.htm

to do with pollution prevention as they do with water conservation. Washing of vehicles is covered in a separate section.

Description of End-Use and Water-Savings Potential

Three areas of operation offer both reduced water- and pollution-loading possibilities:

- proper design of aqueous parts- and brake-cleaning
- preventing pollution and reducing water use in shop-floor cleaning
- proper handling of spent fluids and oils

Aqueous Cleaning Equipment

The development of aqueous parts- and brake-cleaning equipment has been driven by air-quality requirements. Such systems can employ filtration for sludge removal and oil skimming. By filter-cleaning the water, it can be recycled, thus saving on total water-use.

Floor Cleaning

Keeping floors clean in the first place eliminates the need for frequent washing. Methods include:

- installing secondary containers under fluids-storage containers to catch leaks and using drip pans under vehicles being worked on
- using dry cleanup with hydrophobic mops for oil and using absorbent materials (kitty litter, rice hulls, pads, rags, pillows, and mats) to clean up spills
- sealing floors with an epoxy material, which significantly aids in cleanup and prevents oils and liquids from penetrating concrete floors
- providing floor-cleaning equipment that scrubs and vacuums up its own water
- eliminating the use of open hoses for cleanup and using pressure-washing equipment infrequently and for major cleanup events only
- marking drains clearly to ensure that floor drains are clearly differentiated from storm drains and all floor drains are connected to an oil separator

Handling of Spent Fluids

Recovery and recycling of radiator flush-water both saves water and reduces pollution loading. Using storage vessels designed to hold spent antifreeze and other fluids, such as oil and transmission fluid, both eliminates the need to clean and flush these fluids down a drain and is required as part of modern pollution-control methods. Water use in facilities that recycle radiator flush-water has been shown to be less than 10 percent of water use in non-recycling facilities (San Antonio Water System).

Cost-Effectiveness Analysis

A cost analysis of measures to reduce both water use and pollution from the auto-repair industry is now required in part by air-pollution and water-pollution regulations. Offsets to these costs include:

- reduced pretreatment costs
- reduced cost for solvents
- reduced water use

Recommendations

Proven Practices for Superior Performance

- Require new facilities to provide secondary containers to catch drips, leaks, and spills from stored liquids and solvents.
- Require shop floors to be sealed to ensure easy cleanup.
- Require automatic shutoff and solenoid valves on all hoses and water-using equipment, where applicable.
- Require aqueous parts- and brake-cleaning equipment to employ recirculating filtration to minimize the need to dump water.
- Require all drains to be properly identified.
- Have proper facilities for the capture, storage, and recycling of spent fluids, oils, and fuels, including antifreeze and radiator flush-water.

Additional Practices That Achieve Significant Savings

- Have pressure-washing equipment available.
- Have drip pans available at work stations to place under vehicles.

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Printing and Paper Manufacturing

Description of End Use

At first glance, printing and paper manufacturing appear to be very different industries, but according to classification by the U.S. Census and the NAICS — North American Industrial Classification System — paper manufacturing ranges from making paper from trees to manufacturing converted paper products, such as paper containers, cups, boxes, bags, coated paper, envelopes, and stationery products. The focus of this discussion is the manufacturing of converted paper products and printing.

Producing paper from pulpwood and other fiber sources is the beginning process for all paper. It is also the most water- and energy-intensive stage in the life of a paper product. Five gallons of water are used to make one pound of paper (Weyerhaeuser). Recycling paper and cardboard products cuts this energy and water use in half (Kinsella). According to Conservatree, an organization that promotes paper recycling, most repulping for recycled paper is done at pulp and paper mills, where paper is made, or in special facilities that use the product to make such things as cellulose insulation or pulp products, such as egg cartons.

At these pulp and paper mills, a mixture of virgin and recycled pulp is rapidly becoming the most common source of paper and cardboard stock for commercial converted products. The majority of these products will be used for printing, ranging from stationery letterheads to paper bags and boxes (California EPA). Examples of finished products include:

- molded pulp products
- cardboard tubes
- roofing paper
- corrugated boxes
- paper bags
- tissue and toweling
- folded boxes
- cellulose padding

- stationery and envelopes
- paper cups and liquid containers

Operations to make these products do not involve the direct production of pulp, but do involve the processing of paper made from these products. The production of products from paper, cardboard stock, or dry pulp represents the types of operations found in most cities. Major operations most commonly involve:

- cutting and folding
- gluing
- coating
- printing

Cutting and folding, along with the handling of paper stock and products, is principally a dry process. Floor cleaning should follow principles outlined in the section on Cleaning and Sanitation. The last three of these operations involve wet or solvent cleaning of some type. The advent of water-soluble paints and inks has reduced volatile-organic-compound (VOC) emissions, but the use of water as a cleaning agent is more prevalent. The same principles used in cleaning equipment in the food and beverage processing industry apply here, with the addition of solvent cleaning, which is still used in many non-aqueous printing processes:

- Properly remove as much waste product as possible by pouring and storing for future use.
- Scrape equipment and vessels to remove as much waste as possible.
- Use dry brushes, cloths, and paper towels to remove waste.
- Use wet towels or solvent-soaked towels.
- Apply water or solvent only to areas to be cleaned.

Flexography, gravure, screen-printing, lithography, and digital processing are all common printing practices used today. To help save water, energy, materials, and time:

- Design the layout of equipment for easy access.
- Ensure that ink containers are easily sealed.
- Provide non-drying aerosol sprays to keep ink fountains from drying overnight.
- Ensure that presses have proper controls, such as automatic ink levelers.

Water-Savings Potential

The practices discussed above reduce water use by decreasing the amount of cleaning required at the end of the press run. Other water-saving design practices are covered in the chapter on Photo and Film Processing under Commercial Printing. Printing operations also produce large amounts of waste heat in cooling the equipment. Large operations often have cooling towers. In these cases, water-saving techniques outlined in the section on Thermodynamic Processes should be referenced.

Cost-Effectiveness Analysis

Each case is unique, and overall cost analysis is not possible. However, the water-saving techniques outlined above will reduce operational costs by:

- reducing water and wastewater bills
- reducing pretreatment costs
- reducing product loss
- reducing chemical use
- eliminating waste

Recommendations

Manufacturing of Recycled-paper Products

- Properly remove as much waste product as possible by pouring and storing for future use.
- Scrape equipment and vessels to remove as much waste as possible.

Printing Operations

- Design the layout of the equipment to provide easy access.
- Provide non-drying aerosol sprays to keep ink fountains from drying overnight.
- Ensure the press has proper controls, such as automatic ink levelers.

See “Photo and Film Processing — Commercial Printing” for additional recommendations.

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Metal Finishing

The metal-finishing industry offers many opportunities to reduce both water-use and pollution-abatement costs. The plating and anodizing processes involve a multi-tank, multi-step process. Water-saving practices include:

- drag-out control
- good tank design
- efficient rinse practices
- process controls and meters
- chemical recovery
- good exhaust-hood design

As with all industrial and commercial operations, efficient cleaning methods are key practices that will result in reduced water use.

Description of End Use

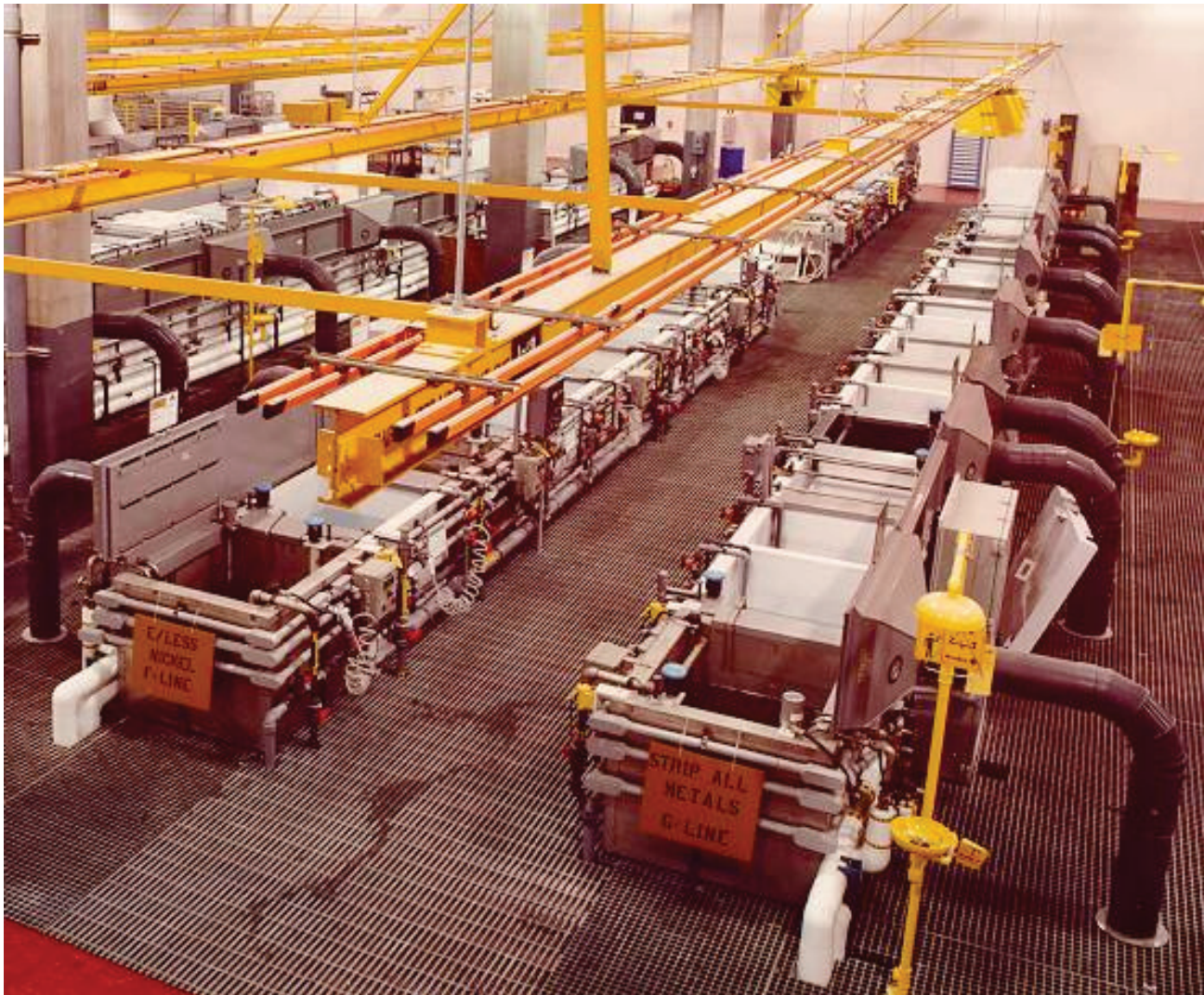
The classic example for the metal-finishing industry was once the plating of car bumpers (when chrome car bumpers were still manufactured). The industry involves much more than that today. For metals, it

includes electroplating, solution plating, and anodizing, but also printed circuit (wire) board and plastic plating. Chrome, zinc, copper, tin, nickel, gold, and silver are among the more common metals plated onto objects. In some processes objects are plated with two layers of metals, such as an under layer of copper followed by chrome.

One common process in this industry is that parts to be plated are moved sequentially from a treatment tank to a rinse or wash tank to another treatment tank to another rinse tank, until the desired number of plating steps have been accomplished. The photograph from the Corpus Christi, Texas, Army Depot, which follows, illustrates the multi-tank configuration of a typical metal-finishing process.

Water is used for the following process purposes:

- chemical and plating solution make-up
- rinsing
- fume-hood scrubbing
- equipment cleaning



**Corpus Christi Army Depot, Corpus Christi, Texas
Advanced Metal Finishing Processes and Facility**
(original date: 01/26/1998; revision date: 04/14/2003)

The typical sequence for plating an object is:

- Clean the object with baths that remove residual oil and dirt.
- Remove rust or oxidation products.
- Immerse the product in a plating bath through which an electric current is passed.
- Wash the parts.
- Either hang the parts being plated from specially designed racks or place them in perforated or woven baskets or “barrels,” so they can be moved easily from one tank to another.

As chemicals from one step build up in the following rinsing tanks or contaminate the process chemicals, water must be replaced. Fumes produced from all of the tanks, and the acid (pickling) and plating processes in particular, must be safely removed with fume hoods which then pass this contaminated air to scrubber systems to prevent air pollution. The typical configuration for these processes is illustrated on the following page.

Water savings can be realized in six areas:

- Drag-out control involves recovering liquid from parts being processed as they are removed from one tank, but before they enter another. The major reason to dump water is contamination of a rinse or process tank with liquid from the previous tank. Methods include:
 - » designing racks, baskets, and barrels so parts drain and do not retain liquids
 - » using turning, tilting, and “bumping” to remove excess liquid
 - » using drip or drain boards to collect and drain liquids back into the source tank
 - » allowing parts to remain over the tank for a few seconds (dwell time)
 - » washing or blowing contaminants back into process or dead tanks using fogs, sprays, or air knives
 - » using wetting agents
 - » using chemicals or heat to reduce plating-solution viscosity
 - » operating the solutions at minimum possible concentration
- The following tank-design methods reduce water use or allow for better reuse and recovery of metals:
 - » using air or mechanical agitation to promote mixing and good contact
 - » hard plumbing all piping so hoses cannot be left on inadvertently
 - » preventing short-circuiting of fluids
 - » sizing tanks to the minimum for the pieces to be plated
 - » segregating waste streams so both metals and water can be recovered more easily
- Efficient rinsing saves water and chemicals and reduces wastewater costs. Methods involve several technologies, including:
 - » using sprays on flat pieces of metal
 - » counter-current rinsing, where the piece is rinsed in successively less concentrated tanks, with the water from the first tank being used as feed for the second, and so on
 - » reactive rinsing, where the rinse water from the final tank is used for the pickle-rinse tank and the pickle-rinse tank water is used as feed to make up the alkaline-rinse tank (see figure following)
 - » air agitation of the tanks
- Flow- and process-control opportunities include:
 - » installing conductivity controllers to discharge water only if the chemicals have become too concentrated
 - » metering makeup water for good process control and to identify problems
 - » using flow restrictors to limit the amount of water being added

- Chemical and water recovery includes several water-treatment technologies:
 - » filtering plating fluid to remove suspended matter
 - » using membrane technology to recover metals and water
 - » using RO or deionization for the feed water for both rinse and process-fluid tanks to reduce interference from other ions
 - » regenerating spent acids
 - » using RO-reject water for cleanup around, but not in, the tanks
- Exhaust-hood design can also reduce water use by:
 - » Recirculating scrubber liquid
 - » Using scrubber water above plating tanks as make-up water for that process
 - » Using RO-reject water or similar reject streams as make-up water for scrubbers for which scrubber effluent will not be reused

Water-Savings Potential and Cost-Saving Examples

Following are examples from real operations of water-saving projects, their costs, and their savings. Because of the varied nature of this sector, each case must be examined separately, but the basic techniques have proven effective to:

- reduce water and wastewater costs
- reduce pretreatment costs
- reduce energy costs
- reduce chemical cost
- increase chemical and metals recovery rates
- reduce labor costs

Because of the wide variation in process design and operations, a simple cost analysis is not possible. Instead, the following examples are provided:

- Example 1 — A small plating shop in Australia that was using 360 gallons of water a day installed drain boards and a deionizer for \$590. The cost for servicing the deionizer is approximately \$780 per year. These measures cut water use by 65,000 gallons a year and saved over \$1,600 in chemical cost each year for a pay back of 1.3 years (Environmental Protection Agency of Victoria, Australia). [Based upon current U.S. dollars adjusted for inflation and currency conversion rate.]
- Example 2 — A large industrial operation in Illinois installed conductivity controllers on two tanks, reducing water use in the first tank from 5.0 to 0.45 gpm and in a second tank from 2.0 to 0.5 gpm. The total installed cost for the conductivity controllers and valves was \$2,000. This saved over 3 million gallons of water a year (Brown).
- Example 3 — A Minnesota manufacturer installed conductivity controllers for \$2,100 and reduced water use by one million gallons a year (Minnesota Technical Assistance Program).

Recommendations

Proven Practices for Superior Performance

- Meter make-up water in new facilities.
- Employ counter-current rinsing.
- Control drag-out by applying at least two of the practices listed above.
- Use conductivity controllers for rinse tanks.
- Install automatic shutoff on all hoses.
- Recirculate water and/or use waste streams as makeup water for scrubbers.

Additional Practices That Achieve Significant Savings

- Employ good tank design.

- Mix or use air agitation of tank contents.
- Use multiple drag-out reduction methods.
- Install filtration and water-treatment equipment, where applicable.
- Use reactive rinsing.

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