Green Considerations in Correctional Plumbing

By Dave Schwartzkopf

Water conservation has taken on a fresh face in recent years. A combination of technological advances, new grading systems and governmental mandates have come together to organize a broad-based drive for more efficient products of all kinds. The cost and scarcity of water has been rising, and projections indicate no end to these current trends, but instead an acceleration of them. Waste-water treatment costs represent a considerable expense. An investment in water conservation now will yield increasing dividends in the future in expenses not incurred. This includes not only the dollars and cents of possible water savings; it also includes the ability to better manage the behavior of users and the conservation of staff resources to not have to contend with plumbing fixture abuse problems that could have been prevented. High-efficiency plumbing fixtures, electronic water management systems and vacuum drainage systems are some examples of the current available technology that can reduce water consumption in correctional facility settings, while minimizing fixture abuse opportunities. These types of products are becoming commonplace in correctional facility construction and renovation projects.

Security plumbing fixtures, like many of their brother-and-sister fixtures in the commercial market, have evolved over time in terms of water efficiency. Great strides have been made to improve the performance and water efficiency of current generation fixtures. While a significant number of existing correctional facilities today still employ toilets with 5 gallon per flush (gpf), 3.5 gpf, or 1.6 gpf water usage ratings, new construction and renovation projects are increasingly incorporating fixtures with 1.28 gpf gravity toilets or 0.5 gpf EVA C vacuum toilets, with EVA C vacuum toilet technology.

“We are commonly replacing broken or damaged vitreous china (porcelain) fixtures. Vitreous china was, and sometimes still is, used in correctional facilities to reduce first costs or to make the facility feel slightly less ‘institutional,’” said Craig Alderson, president of Willoughby Industries. “While first costs may be lower as compared to stainless steel fixtures, time and time again vitreous china fixtures do not hold up in a correctional setting. All too often, broken fixture shards can be used as weapons.”

Alderson explained that his company manufactures stainless-steel, high-efficiency china replacement fixtures that match up to the existing plumbing rough-ins and bolt patterns. When a softer fixture appearance is desirable, the company offers a variety of epoxy powder coatings and hinged seats. These types of replacement fixtures can provide water savings along with a significant upgrade in overall cell security, according to Alderson.

In the case of shower fixtures, older correctional facility shower rooms often had a master valve to activate all shower heads in a room, and the water was left running until the last person left the room. The gallon per minute (gpm) flow rates of the showerheads were relatively unimportant, as water was plentiful and inexpensive. This practice is considered wasteful and expensive today, with the advent of reduced-flow showerheads and water management systems that can control the timing and function of the showers.

Fixture abuse is a common problem in correctional applications, and abuse nearly always involves excess use of water. Extensive examples exist that illustrate the continuous abuse that correctional fixtures and drainage systems experience daily. One specific example is where an inmate housed in a maximum-security cell that contained both a combi-
nation unit and a shower would continue to run his shower (with the shower drain plugged) until the water was about 6-inches deep in his cell. He would then remove the bedding that was damming the water at the door and the water would run out of his cell and create a mess in the hall and into the adjacent cells. In this abuse example, calculations showed that, given the size of the cell and the depth of the water developed, approximately 600 gallons of water were released. While considerable water was wasted, the impact of this interruption in terms of security and property damage was most likely significant as well.

Studies have shown that an average per capita shower time is eight minutes per day. At the high-efficiency shower standards of 2.0 gpm for showers, water usage is only 16 gallons per day per user. For comparison, the same studies show a conservation average toilet use of five flushes per day per user. (Interestingly, a one-time occurrence of the aforementioned abuse example would essentially wipe out the savings generated by the use of a 1.28 gpf, high-efficiency toilet in place of a 1.6 gpf unit for a whole year.) If two inmates inhabit a cell for one year, the annual water savings alone from switching from a 3.5 gpf toilet to a 1.28 gpf toilet would be more than 8,100 gallons per double occupancy cell, assuming full cell occupancy. A decision to build a new facility with a 0.5 gpf EVAC vacuum toilet in lieu of a 1.6 gpf gravity toilet would generate annual savings of over 4,000 gallons per double occupancy cell, with the same assumption being made.

Return on Investment

Most have heard the phrase attributed to Benjamin Franklin that says, “A penny saved is a penny earned.” Someone quipped in a response, “A penny saved is hardly worth the trouble.” In short, the popular saying, together with the one that is not as well-known, encapsulates the dilemma in looking for economic justification for installing new high-efficiency fixtures. While high-efficiency fixtures as a whole might be slightly more expensive than their predecessors, it is quite likely that any additional funds spent on these fixtures would be cost justified in a relatively short period of time.

If we spend a dollar, what can we expect to receive in return? The difficulty in such analysis with regard to water is that it is being compared against commodities that run at the high end of the cost spectrum. The cost of water is commonly cited as being on average around $0.002 per gallon, according to 2009 EPA publication, Water on Tap – What You Need to Know. Add another $0.001 to the water-use equation for the cost of the wastewater, and you arrive at a whopping cost of $0.003 per gallon. By contrast, we face $3 to $4 per gallon in costs every time we fill any vehicle at the gas pump and a very similar per gallon cost when we go by the grocery store to pick up a gallon of milk. It is understandably difficult to become excited about an item that costs $0.003 per gallon when the cost ratio is greater than 1,000 to 1 in comparison with other everyday purchases measured in the same units.

However, while water remains relatively low in cost per gallon, the average cost of water marches steadily upward at well beyond the rate of inflation. We are also several years beyond the data reflected in the EPA publication cited above. Calculations based on a 2013 study of 30 major U.S. cities conducted by Brett Walton of Circle of Blue — titled The Price of Water 2013: Up Nearly 7 Percent in Last Year in 30 Major U.S. Cities; 25 Percent Rise Since 2010 — show rates for a gallon of water ranging from as low as $0.0014 per gallon to as high as $0.0158 per gallon.

While water costs remain comparatively low even with the major increases of recent years in many areas, they are nonetheless a real cost and one that
plumbing fixture choices can be effectively used to minimize. Additionally, many areas around the world face critical water shortages, so water cost may take a back seat to water availability. The key concept in evaluating water conservation choices in fixture selection for an economic perspective is multiplication.

The major multiplication factors to consider are:

- Number of users: Facilities are large and growing larger. Even smaller facilities like small county jails are commonly growing in size. Fifty to 100 cell-size facilities are becoming increasingly common at the county level. At the other end of the size spectrum, larger cities or state institutions often have 1,000-plus bed facilities.
- Number of fixture uses per day (measured in number of cycles or period of time used): Studies have shown, for example, that conservation average use for a toilet is five flushes per day per capita. An average length shower is eight minutes per capita. Whether fixture consumption is measured in gallons per flush or in gallons per minute, those are multiplication factors.
- Number of years of fixture life (years of use): The stainless plumbing fixtures common to jails and prisons are used for their durability. When placed in a facility, chances are that they will be there for the life cycle of the facility.
- Consumption rating of the fixture: This is the fundamental multiplication factor that will be used with all of the other multiplication factors listed. High-efficiency gravity plumbing fixtures as a class provide a 20 percent reduction in consumption from low-flow fixtures mandated by 1992 federal standards. EVAC vacuum plumbing systems feature an even greater water consumption reduction.
- Price of water: As indicated above, prices across the U.S. vary widely, so this factor needs to be tailored for each evaluation. A significant change in this factor will multiply through all of the other factors.
- Future increases in the price of water and water treatment: This can be the gift that keeps on giving from the selection of high-efficiency plumbing fixtures. The future is difficult to predict, but this is one area where forces beyond mere inflation are at work. You can be relatively safe in assuming a substantial future growth in return from any investment made in water conservation.

Depending on the situation, the multiplication can generate significant savings. In scenarios in which water is extremely inexpensive, savings are still possible and worth considering. The real question is likely one of “Why not?” Why not use the high-efficiency generation of fixtures? Objections typically are not cost related since costs are either the same or only slightly higher for the newer high-efficiency alternatives of plumbing fixtures.

Possible Water-Saving Solutions

- Investigate the use of high-efficiency 1.28 gpf gravity toilets in your facility. The high-efficiency 1.28 gpf version of the Willoughby Industries toilet was officially introduced in 2011. Although it looks similar to other prior models of toilets externally, every piece that is part of the finished weldment of the toilet sub-assembly is different. A new trap way, a new bowl, a new waste tube, a new inlet tubing assembly and a new spray ring were all developed to make a unit that not only conserved water, but one that performs reliably as well. It can be ordered as either a stand-alone toilet or an integral part of the many combination fixtures available.
- EVAC, the leader in vacuum plumbing system technology with more than 1,000 systems in operation worldwide, offers a 0.5 gpf vacuum toilet system that employs atmospheric pressure to evacuate toilet waste from the bowl to a vacuum collection tank. This vacuum wastewater collection system also is used for lavatories, showers, urinals, mop sinks and other plumbing fixture types. This system also reduces potential waste-line clogging because of its forced vacuum waste extraction advantage.
- Consider your shower options. In prior times, showers were often ordered with an NFC option (no flow control). In that scenario, water flow was primarily controlled by the water pressure of the supply although it tended to run in the neighborhood of 2.5 gpm. Today, Willoughby offers pressure-compensated flow control models that provide flows of 2.5 gpm down to 2.0 gpm (the new high-efficiency standard) and as low as 1.5 gpm. 1.5 gpm is considered to be the practical low-end limit because of temperature-control risks with scaling that might be encountered below that level.
- Install high-efficiency urinals (HEU’s). Although they are a simpler fixture than a toilet since they only have to evacuate primarily liquid waste, Willoughby created an all-new design to provide the required functions with the 0.5 gpf specified by the new high-efficiency standards. For even greater water efficiency, Willoughby offers a version of the new HEU that is designed for 0.125 gpf.
- Integrate an electronic water management system (WMS). When properly selected and applied, WMS’s offer the opportunity to save water volumes well in excess of what the use of high-efficiency gravity fixtures alone can provide.
- Specify toilets that have toilet overflow prevention technology. Fixtures abuse resulting in cell flooding can be troublesome, expensive and water wasting.

The fact remains that in matters where you have a choice, evaluating all costs is the prudent thing to do, especially on those items that will determine costs for a long time into the future. There is a wealth of information available from others to help. It is important to do your homework, too, especially with information coming from those who stand to gain the most from any decision you make. Nonetheless, they can provide information that is useful. With appropriate care, support and diligence, you can help make your part in a green initiative a successful one that yields ongoing benefits of cost and function for many years to come.