Photo courtesy of Siemens Water Technologies

By B. A. Guttormsen, P.E.

Operating and maintaining water treatment systems that support the utility industry is becoming increasingly challenging in our current economic environment. These systems have aged, along with the power generation equipment they support, and extending their useful life has become the objective of many in the industry as they strive to maintain production at the lowest possible cost.

This is true not only of the utility industry, but in petrochemicals, pulp and paper, and in the public sector as well. Water treatment systems represent a very significant component of our infrastructure, and this equipment in many cases is approaching, or has already exceeded, its original planned useful life. Following are other factors that complicate the situation as well.

Today's challenges

Lack of experienced personnel

Organizations find themselves in an environment where those with many years of experience supporting these systems have reached retirement age, and passing the torch to younger less experienced operators has not been as successful as hoped due to changing times and increasing turnover. In addition, competitive realities mandate the need to do more with less. More specifically, it is to use fewer operators to monitor the operation of the equipment. This works to some degree, with the use of advanced control and monitoring systems, but may not allow for the time required to perform careful on-site observation of the equipment and its needed planned maintenance.

Loss of system documentation

Ideally, system documentation originally provided by the equipment manufacturer has been readily available to operators and has been well used, including markups and notes specific to the local needs of the site. However in many cases it has been damaged, worn, or lost; and the relevant drawings and instructions are not available to assist the operator in troubleshooting the equipment and providing the maintenance it requires. This can also cause a gap to occur in the communications between the end user and the original manufacturer when support is required.

Water source changes

Water treatment systems are specifically designed to treat the influent having the originally specified water analysis, which is the design basis. Over a period of time, this analysis can change, whether the source is surface water or well water. Surface waters can become more difficult to treat with increases in the level of organics or other substances. Well water production limitations can create the need to change wells, with attendant water analysis changes. These changes can significantly affect the system and require, as a minimum, a review of the design with resultant changes that can range from small adjustments to re-evaluation of the process design, with major reconfiguration of the equipment components. In many cases, the result is trying to use the existing equipment to treat a more difficult water.

Treated water quality and quantity demands

Quality and quantity requirements of water produced typically change over time. Equipment manufacturers that use water typically specify improved water quality to support the equipment they produce as their technology advances. In the public sector, newly published regulations lower the acceptable levels of impurities in drinking water. In both cases, this may push the limit of the water treatment systems originally supplied beyond their capability to produce this level of quality.

Quantity requirement changes also affect the system performance. This can occur in the form of both a reduction in water needs, as well as an increase. Reductions usually occur when plant capacities are downsized, and the water quantity requirements are lessened. Users are faced with the alternative of reducing the number of units on line, or operating them all at reduced capacity. Increased flow rate requirements are seen when plant capacity increases, and this can happen without regard to changes to the water treatment system that support it, unless proper planning is done.

Regardless of whether flow rate demand is increased or decreased, these changes in quantity can result in a drop off in the quality of water produced. In the case of reduced demand, pretreatment clarifiers may require a minimum rise rate to perform successfully. On the other hand, higher flow rates than designed may increase the rise rate to the extent that there is a carry over of floc. Similarly, ion exchangers require a minimum

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Siemens pressure filters completed in shop assembly.

flow rate to avoid channeling in the bed, or in certain circumstances to avoid precipitation in the bed. However when the flow rate is too high, the kinetic properties of ion exchangers can result in a loss of quality when velocity through the bed is excessive.

Environmental factors

Limitations on allowable discharge of wastes, both in terms of the amount and its characteristics, usually are imposed many years after the original equipment design. Minimizing waste production and discharging a neutral waste have mandated system changes that can compromise the capability of the equipment to produce the originally intended quantity and quality of treated water.

Equipment deterioration

Probably the greatest challenge facing users is the limitation created by the condition of the equipment. Internal process related corrosion and external corrosion caused by exposure to local atmospheric air and its contaminants play a huge role in limiting the useful life of the equipment. Harsh exposures, combined with inadequate internal and external protection of carbon steel surfaces, significantly shorten equipment life.

Opportunities

From this list of challenges, opportunities arise that can lead to a more optimized use of existing equipment under changed conditions, and an extended useful life. The challenge is to take advantage of these opportunities, and reconfigure where necessary to produce in a more effective system design. *The cornerstone necessary to achieve this is a fresh look at the basic process design.*

Process design

Consider the current conditions of raw water quality and the current requirement for quantity and quality of treated water. Can the existing technology produce the desired results? If so, what changes are required to the existing equipment to run under the current conditions? What restoration effort is required to bring the equipment into an effective operational mode? Would the existing system benefit from the application of newer technology? Could this be used in conjunction with the existing equipment to create a more optimal situation? Only after addressing these process issues can the other opportunities be evaluated.

Instrumentation and control systems

Many existing water treatment systems can benefit from the addition of, or replacement with, improved on-line analytical devices that more accurately monitor system results; and with current control systems that more consistently control their operation and the operation of support equipment such as chemical feeds and regeneration equipment, and other auxiliary devices.

Equipment restoration

Much of the water treatment equipment that makes up this part of our infrastructure is serviceable, despite its age and condition. Techniques that can be used to verify this are evaluations of plate thicknesses for Code compliance; and physical inspection to determine whether internal and external components can be utilized in their current condition, or require restoration or replacement.

For steel pressure vessels and gravity tanks, this would be the time to evaluate the cost and benefit of recoating, internally and/or externally, for improved corrosion resistance to extend the useful life of these primary components.

Planned maintenance

This would also be the time to put into place a schedule for the routine maintenance procedures recommended by the manufacturer. Updating the inventory of recommended spare parts is also in order, particularly if there are long lead items.

Updating system documentation

Manufacturers of water treatment equipment that archive drawings and instructions can make them available if replacement of this documentation is required. When reconfiguring existing systems, new process documents should be prepared and made available as part of the work scope.

Conclusion

There are many water treatment systems in existence that may not be operating optimally, however with a fresh look at process design, and implementation of the resultant findings, these systems can operate in a more optimal fashion well into the future. There are many tools available to accomplish this, including expert process design by a water treatment technology leader.

A comprehensive evaluation of process design by a full service water treatment company can include raw water analyses, comparison of alternative water supplies, evaluation of appropriateness of existing treatment technologies, benefits of supplementing with other technologies, and adjustment of chemical dosages to produce desired results at lowest possible cost. In addition, on site inspection of equipment is done to ensure it is in serviceable condition.

Other tools available include advanced instrument and control systems, and newer water treatment technologies. These could include advanced ion exchange applications, membrane applications, and CDI as examples. In addition, greater emphasis on planned maintenance can contribute significantly to extending the useful life of the equipment.

In our infrastructure there exists a tremendous investment in water treatment systems. Using them wisely makes good economic sense, by minimizing our need for new equipment, effectively applying new equipment or technologies when needed, and operating and maintaining the systems more efficiently to reduce operating costs.

Photo courtesy of Siemens Water Technologies

Siemens Water Technologies replacement parts available to support the IWT line of equipment (resin traps and laterals).

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