

Improved Sprinkler Uniformity Can Save Water and Energy

In 2003, a sprinkler irrigation efficiency study was conducted by the The Center for Irrigation Technology on behalf of the California Department of Water Resources. The purpose of the study was to determine actual water savings at 6 California golf courses that retrofitted their sprinklers with after market nozzles designed to improve water uniformity.

Superintendents at each of the courses had decided to upgrade their sprinklers with the high uniformity nozzles because of the poor performance of their existing sprinkler systems and the resulting deterioration of the turf quality. One of the participants in the study was the Los Angeles Country Club. Their sprinkler system was operating at a relatively low 55 psi and the un-uniform sprinkler pattern (as evidenced by repeating wet and dry spots between sprinklers) was apparent on every fairway of the 36 hole course. The factory nozzles were tested. The DU and SC were measured at 73% and 1.5. The retrofit nozzles were later tested. The DU and SC improved to 85% and 1.2. After the retrofit, turf quality was noticeably improved.

Using the SC method, average water savings at all six courses was estimated at 30% and the DU method was estimated at 9%. The case study actually proved that the average water savings was 6.5%. Individual golf course water savings ranged from positive 21.4% to -11.3%. The extreme range of savings between courses was due to the fact that a lack of uniform irrigation forces irrigation managers to choose one of the following options:

- 1) To irrigate the dry spots to an acceptable level of green by severely over irrigation the rest of the turf grass.
- 2) To irrigate the initial development of any wet areas, and severely stressing the drier areas, or
- 3) To irrigate to the initial development of any wet areas then utilize hand directed watering at considerable expense to irrigate the dry areas to an acceptable level of green color.

None of these three options is desirable. Improved irrigation uniformity may not provide large savings in applied water if the course is generally under-irrigated (large dry areas). However, it is likely to significantly reduce the need for hand-watering, which is inefficient, costly, and disruptive to the golfer.

In reality, the calculated savings align closely to observations made by one of the superintendents who acknowledged consciously reducing ETo by 5% after installing the

new nozzles. The course that experienced an increase in water application had suffered such bad uniformity that the superintendent was never able to apply the required amount of water to maintain acceptable turf quality. After the retrofit, the superintendent was able to apply adequate water to the driest zones and subsequently used more water than previously. Such extremes are not common and a substantial water savings can usually be expected.

Return on Investment

None of this improvement in uniformity can persuade a General Manager unless there is a payback on investment. In order to estimate the payback period, we need to know the value of the acre feet saved and the initial investment. A simple payback equation would look something like:

Number of years = Investment / Annual Return

For example, let's assume the one-time investment cost of nozzle replacement at \$12,000. The cost of water and energy is \$361 an acre foot. The total volume of water saved each year is 16.6 acre feet.

Two years = \$12,000

Thus, if a golf course superintendent was operating under the average conditions outlined above, the payback period for investing \$12,000 to re-nozzle the sprinkler system would be two years based on the volume and cost of water and energy saved. Water and energy costs higher than this would provide a shorter payback period, while lower water and energy costs would require a longer payback period to recoup the investment. Also, higher or lower initial re-nozzling costs would affect this estimate.

Energy Costs

All water used for the purpose of irrigation in a golf course is pumped. Therefore, every gallon of water delivered to the field has some energy cost associated with it. The more water and pressure we use, the more energy we consume. Conversely, reducing the amount of water applied and/or reducing the operating pressure will minimize the total cost of energy. During the energy crisis of the 1980's, Toro introduced a low pressure sprinkler that performed well at 50 psi and saved much energy. Operating pressures of today's golf course irrigation systems never drop below 65 psi.

Conclusions

While the numbers present a quantitative view of the benefits of improving irrigation uniformity through selected nozzle changes, the superintendents provided insight into the perceived benefits of a more uniform irrigation system. Selected quotes include:

“Dry spots and wet spots are much less numerous”

“We are able to run sprinkler heads longer without puddling”
”Turf areas had many donuts throughout the course. The new nozzles evenly distributed the water reducing and eliminating this issue on my golf course”
“After installing the new nozzles I was able to reduce the ET demand 5% lower than the previous year.”
”Significantly improved coverage”
“Less water around the head with mud and mess”
“Better performance in higher elevation pressure sensitive areas”
“Well worth the investment”
“It has reduced our hand watering requirements, perhaps savings around \$8,000 per year”

Not all the superintendents were able to document a net savings in water and energy from the installation new nozzles, but all five superintendents did see improvements in the quality of their turf grass from better water distribution. They indicated no hesitation in recommending re-nozzling of sprinklers to other superintendents who are facing the same lower uniformity issues seen in the study.

The basic lessons learned were:

1. It is very important to know the distribution uniformity of your existing irrigation system.
2. If improvement is warranted and the existing sprinklers are in good condition, re-nozzling with proven nozzle designs should be considered.