CALCULATING SPRINKLER RUN TIME

By Tom Emmerich

As we enter the decade of the nineties, every magazine and television news program is either reminiscing about the eighties or speculating about events to come. One issue in the nineties that is certain to affect the turfgrass industry in the water-rich midwest is the efficient use of this valuable resource.

This issue has already become a realism to golf course superintendents who rely on surface water for their irrigation needs. The Wisconsin Department of Natural Resources has placed greater pumping restrictions on golf courses, diverting irrigation water from lakes, rivers and streams. These restrictions have taken the form of limits on the maximum gallons per minute that can be diverted, what months of the year the water can be taken and the total amount of pumping hours allowed. Worst of all, a low level benchmark is set, which when reached, all diversion of water must stop. Beginning this year the DNR is also assessing a water withdrawal fee based on the average daily usage in gallons during the maximum withdrawal month. These fees will range between $45.00 to $600.00 and are earmarked to fund programs that will enhance the conservation and protection of water resources in the State of Wisconsin.

This is the scenario for the Spring of 1990. What does the future hold? How about tighter restrictions governing the diversion of surface water? Pumping limits on high capacity private wells? Restricted use of municipal water for turf irrigation? Water withdrawal fees for high capacity wells similar to the current surface water program? All are possible. We must learn to be more efficient in our irrigation practices today in order to be prepared for the increased cost of tomorrow's water.

One way to irrigate more efficiently is to avoid setting the run time for your sprinkler heads for the hot and dry time of the season and then operating them this way in spring and fall. The overwatering that results wastes energy dollars and water. Run times should be based on the precipitation rate of the sprinkler, the time of year and varying weather conditions.

Though no one is better qualified to determine how much to water the greens, tees, and fairways than the person responsible for maintaining them, the following information will be useful in helping you tailor an irrigation system to your needs.

The optimum run time for a sprinkler head can be calculated using two mathematical formulas. The first formula is used to determine output of a sprinkler head in inches of precipitation per hour of run time. Thus it is called the *precipitation rate formula*. The second formula utilizes this precipitation rate along with the required amount of precipitation per week and the frequency of the watering cycle to determine the actual minutes of run time per cycle. This is the *station run time formula*.

First, let us deal with precipitation rates. To use the precipitation rate formulas, you must know the amount of water discharged by the sprinkler in gallons per minute, the distance between the sprinklers in feet and in what pattern they have been placed. This pattern is called the spacing. Spacing is typically square, triangular, or single row. The term "70 foot square" refers to sprinkler heads spaced 70 feet apart in a square pattern.

The precipitation rate formulas are:

SQUARE SPACING

$$\frac{96.3 \times \text{G.P.M.}}{\text{SPACING SQUARED}}$$

TRIANGULAR SPACING

$$\frac{96.3 \times \text{G.P.M.}}{\text{SPACING SQUARED} \times .866}$$

IN LINE SPACING

$$\frac{96.3 \times \text{G.P.M.}}{80\% \text{ OF SPRINKLER DIAMETER} \times \text{SPACING}}$$

Here are some examples to illustrate the use of these formulas.

SQUARE SPACING
Typical Application - Greens

Sprinkler G.P.M. = 30
Spacing = 70 feet square

$$\text{Precipitation Rate} = \frac{96.3 \times 30}{70 \times 70} = \frac{2{,}889}{4{,}900} = .59 \text{ inches per hour}$$

TRIANGULAR SPACING
Typical Application - Tees

Sprinkler G.P.M. = 30
Spacing = 70 feet triangular

$$\text{Precipitation Rate} = \frac{96.3 \times 30}{(70 \times 70) \times .866} = \frac{2{,}889}{4{,}243} = .69 \text{ inches per hour}$$

IN LINE (Single Row)
Typical Application - Fairways

Sprinkler G.P.M. = 56
Sprinkler Radius = 90 feet
Spacing = 90 feet in line

$$\text{Precipitation Rate} = \frac{96.3 \times 56}{(180 \times .80) \times 90} = \frac{5{,}393}{12{,}960} = .42 \text{ inches per hour}$$

Now that we know the precipitation rate of the sprinkler, the actual minutes of run time can be determined. For this calculation, the Station Run Time Formula is used.

STATION RUN TIME FORMULA

$$\text{Run Time in minutes per cycle} = \frac{\text{inches of precipitation required per week}}{\text{number of cycles per week} \times 60 \text{ minutes per hour}} \Big/ \text{precipitation rate of the sprinkler}$$

Let's calculate the sprinkler run times of our previous examples. For this exercise, the desired precipitation rates are 1.5 inches per week on the greens and tees and ¾ inch per week on the fairways. The system will be programmed with one cycle per day, 7 days per week.

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GREENS

$$\frac{1.5}{7 \times 60} = \frac{.214 \times 60}{.59} = \frac{12.84}{.59} = 22 \text{ minutes per cycle}$$

TEES

$$\frac{1.5}{7 \times 60} = \frac{.214 \times 60}{.69} = \frac{12.84}{.69} = 19 \text{ minutes per cycle}$$

FAIRWAYS

$$\frac{0.75}{7 \times 60} = \frac{.110 \times 60}{.42} = \frac{6.43}{.42} = 16 \text{ minutes per cycle}$$

Now that we have this data, how do we put it to use? First, determine what your weekly precipitation requirements are for each month of the irrigation season, say April through October. Make a chart with the months across the top and the locations (tee, greens, fairways, etc.) down the side. Calculate sprinkler run times based on the weekly precipitation rates and fill in the chart. Use the chart to reset the station run time of the field satellites each month. See the schedule below.

A faster and simpler way to vary the sprinkler run time is to set the field satellite stations at the shortest run time required during the season. Then program the central controller for multiple starts to increase the total amount of irrigation. Be sure to program the start times far enough apart so that the current cycle is complete before the next one begins. This method of multiple start short cycle watering can also save water by eliminating runoff on tight soils.

Today, irrigation equipment manufacturers are providing our industry with computer operated control systems that automatically change the sprinkler run times on a daily basis. These systems measure the day's weather conditions and calculate the Evapotranspiration rate or Demand ET. This is the total amount of moisture lost through evaporation from the soil and transpiration from the turf. The system then looks at the precipitation rate of the sprinklers and sets their run time to provide the turf with the exact amount of moisture required to replace Demand ET.

Computer based ET driven irrigation control systems are one way to make the most efficient use of water and energy in turfgrass irrigation. For many whose budgets don't provide for these high tech control systems, calculating and using the proper run time for your sprinkler heads is the quickest way to irrigation efficiency.

Editor's Note: Tom Emmerich is the Irrigation Division Sales Manager at Reinders Brothers, Inc. and a Certified Golf Course Irrigation Designer. He earned a business degree from UW-La Crosse and has been in the irrigation business for 20 years. Tom has previously contributed to "The Grass Roots".

IRRIGATION SCHEDULE FOR ABC GOLF COURSE

MONTH	April	May	June	July	Aug.	Sept.	Oct.
Inches/Week	0.50	0.75	1.25	1.50	1.50	1.00	0.75
Sts./Wk.	7	7	7	7	7	7	7
STATION RUN TIME IN MINUTES FOR:							
Greens	7	11	18	22	22	15	11
Tees	6	9	16	19	19	13	9
Fairways	10	15	26	31	31	20	15