IN-STEM FLOW REGULATION

Abstract

The author is an experienced landscape and irrigation licensed contractor with almost 60 years of active participation in the industry. In 2002, the author invented and patented the "Little Valve" technology for pop up and above-grade spray heads in order to make the maintenance of spray nozzles and subsequently, rotating, multi-stream nozzles faster, easier and much more efficient. Up to this present time, this was and is the first significant change to sprinklers in almost 60 years. In follow-up testing beginning at the Center for Irrigation Technology, it was discovered that the "Little Valve" technology offered unique water and labor saving features, notably, during installation and maintenance. This was followed by testing showing increased distribution uniformity of conventional 15" spray nozzles adjusted to 15', 12', 10' or 8' when compared to MPR nozzles designed to perform at these same distances at 30 psi and tested also at 55 p.s.i. In addition, the technology made it possible to eliminate over-spray and high pressure misting at pressures up to 165 psi, giving the installing or maintenance contractor the ability to precisely control the distance of throw of any individual head.

In the 2010 – 2011 period, the water-saving characteristics of the technology were further confirmed under the auspices of the Innovative Conservation Program (ICP) of the Metropolitan Water District of Southern California (MWD). The audited trials showed an average water savings of 30.2% with the "Little Valve" technology. This, in turn, led MWD to add the "Little Valve" components to its commercial rebate program. When the Water Management Usage Division of the Municipal Water District of Orange County published its "Cost Effective Analysis – Existing Programs" report, the "Little Valve" components were identified as the most cost-effective water-saving technology available in the marketplace.

A Lecture on the Many Benefits of In-stem Flow Regulation (IFR)

Author: Ted Sirkin, Irrigation Designer & Consultant
California Landscape Contractor's License No. 217789 (1963)
Owner: Valvette Systems, Woodland Hills, CA

Prior to the In-stem Flow Regulator's introduction, it was virtually impossible to remove and replace nozzles without one person at the controller or the RC valve and another at the sprinkler to remove and re-install the nozzle OR for one service person to go back and forth to the valve or controller two or three times, shutting off the system, then going back to the problem sprinkler, all of which was very time-consuming. The only other method for one person was and is using remote-control units, which were then just gaining popularity but were often unreliable and in other cases were in the shop for repair or had just simply been forgotten when the crews left in the morning. Even today, remote control units can be time-consuming in their operations meaning slow to turn on or shut off a valve, and when connecting up to a controller. Range and interfering structures or topography is another inhibition facing remote control units. For the long-range units, even today cost can be a deterring factor, as well as the need to connect wires to each and every station on a controller. Yet, back at that time, there simply was no other way for one person working alone to be able to shut off a sprinkler in the middle of its operation for servicing clogged nozzles, flushing out dirty lines and nozzle change-outs.

Hence, In-stem Flow Regulation (IFR) was initially created to make sprinkler head maintenance and installation easier by providing a means for one person to approach a pop-up or above-grade shrub adapter sprinkler with a clogged nozzle or desiring to change out or replace an existing nozzle, to be able shut off the water to that one particular sprinkler all without shutting off the other sprinklers within the same valve system and upon completing the task, be able to turn the one sprinkler back on and move onto the next problem. Another major problem that always occurs when one is servicing pop-up sprinklers is when the nozzle is removed, the pop-up riser stem will slide down back into the pop-up body with or without the water being on. In the case of the sole existing IFR presently in the marketplace, the adjustment screw and its surrounding material provide a surface for the incoming water to keep the pop-up elevated while the nozzle is being worked on, hence rarely, if ever, does the pop-up stem retract until the RC Valve has been shut down.

The first testing on In-stem Flow Regulators was performed at the Center for Irrigation Technology and was conducted by Ed Norum, a former director and long time consultant with the C.I.T. The finished results were titled "Detailed Analysis of the Testing Results for LittleValve Sprinkler Parts. [1] The testing centered on the water and labor savings IFRs provided under a variety of normal field circumstances with simulations for both new installations and post-installation maintenance work. In the majority of trials, significant water and labor savings were achieved versus non-LittleValve sprinklers and parts. In the 'Maintenance' trials, savings of 66% less labor and 36% less water were reported. See the full Report at ValvetteSystems.com in the sub-section "Test Data & Water Savings Reports" under the 'Think Water Conservation' tab.

There is an interesting aside to this discussion of the C.I.T. testing: It was not until 6 or 7 years later that this author started touting the 'pressure regulating' benefits of these products as he did not yet have a good grasp of that benefit the products offered. It was a work in progress over the first 5 years wherein the water saving benefits started taking form. The only awareness that the author had about pressure regulation during that time period was that even if the pressure was 165 psi, the LittleValve, consisting of a 3/8" diameter stainless steel set screw introduced into a reduced-diameter water passageway of a sprinkler part, would, in fact regulate water flow allowing a 15-ft nozzle to be reduced down to about 6 feet, allow for 98 -99% shut down of a sprinkler for maintenance purposes while others on the same line were still operating, save water by eliminating overspray onto streets, sidewalks and buildings and when using a 15-ft nozzle at distances of 14 feet or less all misting/fogging would go away and cease to exist. In fact, as opposed to 5-ft and 8-ft nozzles, which cause misting and fogging sometimes at even low pressures, the more the radius distance is lowered with 15' nozzles connected to IFRs, the less possibility of misting/fogging.

However, Mr. Norum was aware of it and made this notation in Page 4 near the end of the final analysis: "If pressure regulators are not used, then the headloss introduced by the Little Valve is beneficial in reducing the operating pressure to values closer to the range of operating pressures under which spray heads were designed to operate. Further, the adjustable feature of the LittleValve allows it to introduce the additional headloss required to match the supply pressure to the design pressure."

The benefits of using primarily 15-foot nozzles and avoid using 5', 8', 10' and 12' nozzles became evident with the 2004 testing conducted by Joe Kissinger, a certified irrigation auditor and a part time irrigation teacher At Cal-Poly, Pomona, working under Dr. Joseph Hung, Professor Emeritus, as the Technical Adviser. Kissinger brought Dr. Hung onto the team to help determine why he was saving water during the testing. At that time, Dr. Hung, the no. 1 irrigation hydraulics expert in the western USA, was

[1] LittleValve is the registered name for this technology manufactured and distributed by the inventor. However, in 2011, the Metropolitan Water District of Southern California (MWD) gave it the generic name of In-Stem Flow Regulator when it became the first and only sprinkler part on the MWD's rebate list

able to figure out that the reason LittleValve parts saved water is because a chamber is created between the IFR plug area and the nozzle, hence the water swirling around the inside of the chamber eventually goes up into the nozzle but with considerable less turbulence than being shot straight into the nozzle through a pop-up stem or sprinkler riser. The water entering into the nozzle with less turbulence allows the water to exit the nozzle more efficiently. Through their testing, Dr. Hung and Joe Kissinger were able to determine that the chamber caused the 15-foot nozzle to emit water with higher uniformity than the same nozzle, at the same pressure as on a regular sprinkler.

Then in 2010 -2011, those benefits became further memorialized in the trials conducted under the auspices of the Innovative Conservation Program (ICP) of the Metropolitan Water District of Southern California (MWD) in cooperation with the U.S. Department of Reclamation. [2] Four of the five one-year long trials were devoted to recording monthly water usage in turf and shrub areas with 8 separately-metered RC valves using Neptune meters from 1" to 1 ½" to record flow separately for each valve. One valve in each trial measured the water usage of X number of IFR sprinklers, mostly pop-ups whereas the other valve in that same trial had an equal number of non-IFR sprinklers. All the sprinklers and all the nozzles were brand new. Two of the trials were in turf locations and the other two were in shrub areas. One turf trial and one shrub trial was in the Los Angeles Dept. of Water & Power service area (LADWP) and one turf trial and one shrub trial was in the Las Virgenes Municipal Water District (LVMWD). Each month the author, accompanied by the conservation guru from each water district, would go to the trial sites in their respective districts and read the meters together. This was done to assure the veracity of the results through 3rd-party verification of all meter readings.

After the meter readings at each test site, a very important process would take place. The water agency guru and the author would take a substantial number of soil probes at each test area and closely examine the samples in order to jointly agree on the water times and frequency of each station for the ensuing one-month period. The watering times and frequencies of each station were then adjusted accordingly. In the opinion of this author, nothing can beat a 3-dimensional examination of the soil moisture.

Both turf trials and one of the two shrub trials took place in 12-ft wide median strips. The sprinklers were properly spaced on 12-foot centers and alternate-spaced on both sides of each median. In these 3 IFR areas, new 15-ft Rain Bird nozzles were used and in the 3 non-IFR zones, new 12-ft Rain Bird nozzles were used. That means the nozzles in the IFR areas did NOT provide matched precipitation. Yet, an examination of pages 9, 10 and 12 of the MWD testing, the 3 pages devoted to the results of these 3 trial areas, shows that the water savings of non-MPR nozzling connected to IFR sprinklers exceeds the water savings expected from the use of MPR nozzles. The percentage of water savings in the 3 trials range from 22.7% up to 33.5%. When the results of the non-median shrub area trial are included, the average water savings of the four IFR zones compared to the non-IFR, MPR zones reduced water use by 30.23%. (See page 13 of MWD report.)

One of the most notable findings that came from monthly evaluation of soil probe samples at the test sites is that the droplets from 15-ft nozzles are larger in diameter and heavier than the droplets from the 12-ft nozzles; and even more so when compared to droplets from 10-ft and 8-ft nozzles. The author and the water conservation gurus deduced that the larger droplets penetrate the ground deeper, diffuse throughout the soil more widely and certainly resist wind drift much better. This is a good place to note that due to the water savings results from the IFRs participation in the Innovative Conservation Program, the IFR sprinkler parts are the ONLY actual sprinkler parts on the MWD's commercial rebate list. The other major items associated with sprinklers on that list are high-efficiency nozzles and high-tech 'Smart' controllers.

[2] The MWD is the nation's largest water purveyor of treated water serving over 19 million customers over 5 counties via 26 member agencies..

There are, of course, some exceptions to using just 15-foot nozzles. Rain Bird and Toro both make flat spray nozzles. The writer is not aware of a designated flat spray nozzle being made by Hunter, K-Rain, Weathermatic or Hit. As mentioned above, 15-foot nozzles can be brought down to about a 6-foot radius and do a good job of watering when properly spaced. However, the question is, "What nozzle do I use if I want to water less than 6 feet or even lower." That's where the flat spray nozzles come into the picture. Connected to IFRs, Rain Bird's 8-foot Flat, one of Rain Birds grey-colored specialty nozzles, and Toro's Black Flat – that has no radius designation – are simply the world's BEST micro-spray applications anywhere and with the best looking patterns. If you seek a low-volume micro-spray sprinkler with a distance range of 6 feet down to 2 – 2 ½ feet, you will find that those two nozzles will do the watering job you want with little or no maintenance problems normally encountered with all other micro-spray application products. And to top it off, all pressure-regulation concerns normally associated with micro-spray sprinklers are non-existent.

The next group of nozzles benefiting from IFRs is a boon to most irrigators in that it solves a problem heretofore not really solvable. We're talking side strip nozzles. In most cases, side strip distances are 4-5 feet in front of the nozzle and 15 feet to the left and 15 feet to the right. The single biggest problem with side strips is when you adjust them down to lower than about 9 feet left-right; the nozzle ceases to emit water out in front of itself. It basically becomes a center strip nozzle at that point, which doesn't respond well to being adjusted via the little screw on top.

Hunter and Rain Bird's rotating side strip offerings provide a much different watering pattern than the spray-type side strips do. Hence, excluding those rotating models, there is one spray-type side strip that is different from all the others and that is Hunter's SS530. Its difference is that it is a "5-by" side strip rather than a "4-by". Hence, when connected to an IFR, the SS530 can be taken down to as low as 2 – 3 feet left/right and there still is water coming out in front of it. Because of that feature, the SS530 can actually be turned into another micro-spray nozzle similar to the Toro and Rain Bird Flat sprays only with a more elongated spray pattern.

To help get past that problem of a "4-by" becoming a center strip nozzle, Toro's newer line of Precision Spray Nozzles (PSN) has two spray-type side strip offerings: 4 x 30 and 4 x 18. The 4 x 18 can be used for tighter areas than can be served by a typical 4 x 30.

But now with In-stem Flow Regulators, all side strips can be controlled so that the installer no longer has to live with a 30-foot wide pattern. Side strips can now easily be taken down to 10 feet left/right before water stops coming out in front and oftentimes eliminate water being thrown onto the front entryway of a home, apartment or over-spraying onto a parking lot. It should be noted, however, that with IFRs, one gains a lot more precision placement of the water with spray-type side strips than with the rotating models.

As a side note, be aware that when encountering a planter area that is less than two feet wide, this IFR irrigator has learned that he can only use Rain Bird's 15SST for those areas. When turning the IFR down to confine the pattern within the two feet, the nozzle will act as a center strip but the side throws can be better contained within the 2-foot width than other side strips.

A final note about side strips deals with those occasions when, for various reasons, side strips need to be mixed in with rotating nozzles on the same valve system. Excluding the two 5-foot rotating side strip nozzles on the market, under normal circumstances we have learned that only the PSN 4 x 30 side strip nozzle can be mixed in with other rotating nozzles on the same system and be brought down to about 8 – 10 feet left/right or lower but at the sacrifice of no water out in front. The reason is simple: The PSN side strip is the only spray-type that has flow rates similar to those of all the rotating nozzles. If spraying the side strip less than 5 feet left/right, then Hunter's SS530 can generally be used with rotating nozzles.

But, now those rotating nozzles will be discussed in more detail because In-stem Flow Regulators are making a very large impression in conjunction with rotary or rotating nozzles. Of the four major rotary nozzles on the market with which this author is familiar, the IFR works "magic" on two of them but still provides benefits to all four.

Just for clarity, even though many of you here already know this, the stated low-end radius distance for MPs is 6' on the new 800 model and 8 feet on the 1000 model, K-Rain's minimum distance is 13 feet, Rain Bird's new RVAN14 minimum radius distance is 8 feet and that is for adjustable models only as the full circle minimum is 17 feet. And Toro's PRN has a minimum distance of about 14 feet if the pressure is at 30 psi. If the inlet pressure is higher, the minimum distance increases.

There are two major differences between the Toro and Rain Bird offerings versus the Hunter and K-Rain models. The first difference is the Toro rotating nozzle and Rain Bird's adjustable rotary nozzle have an arc range of 45° to 270°. With one minor exception, the other two have a minimum arc of 90°. The big difference insofar as IFRs are concerned is in the inner construction of the nozzle. When one turns down the radius of a Hunter or K-Rain rotary below its stated lower distance, the mechanism stops turning as it basically needs a certain amount of water flow to keep it rotating.

That is NOT the case with Toro or Rain Bird rotating nozzles when paired with In-stem Flow Regulators because the operating mechanism of those latter two function more like a gear-driven sprinkler. Hence, by having an IFR under a Toro or Rain Bird rotating nozzle, you can reduce the radius way, way beyond its stated minimum radii and that's where the magic comes into the picture.

Recently, Toro has been experimenting with IFRs and after examining the results of pairing their Precision Rotating Nozzle (PRN) with the IFR, Toro has found that it has the largest distance range of any rotary nozzle on the market. It has also learned that it only needs one size of PRN. Generally speaking, the maximum distance of a PRN is around 20 feet up to about 25 feet depending on pressure. However, when looking at minimum distances, no other rotary nozzle can compare with the PRN when it's paired with an IFR. When connected to an In-stem Flow Regulating sprinkler, the PRN distance can easily be brought down to 18 inches or even lower, regardless of pressure. That means the IFR gives the PRN a range of 18 inches all the way up to 25 feet. That's a huge radius-distance range.

Following close by is Rain Bird's 17-24 foot model. The 17-24's ability to reach 20 – 25 is also affected by pressure. However, regardless of pressure, when paired with an In-stem Flow Regulating sprinkler, the 17-24 can easily be brought right down to 4 – 5 feet. Hence, an IFR gives the 17-24 a range of 4 feet up to 25 feet, also a big radius-distance range of coverage. Under 4 feet, it pretty much stops rotating, but effectively, IFRs make Rain Bird's other two sizes obsolete.

Radius reduction of a rotary nozzle without an IFR in the picture can be tricky. Hunter's 1000 model and its newer 800 model each have a shorter minimum radius of 8 feet and 6 feet respectively. However, where water pressures exceed 55 – 60 psi, it is not likely one will easily or always be able to get down to those two radius distances. Hence, Hunter promotes pressure-regulating stems partly as way to accomplish the minimum distances; but even then, it's still not always easy to do especially if you have a system designed with high volume in mind. Here in Southern California where water pressures tend to be on the high side, this author, who is also a licensed landscape and irrigation contractor, has oftentimes struggled to bring down that 1000 model to below 9 feet - even with an IFR, although other contractors have told him that with IFRs, they are able to do so easily. Consequently, with Hunter or K-Rain rotating nozzles, when you turn down the adjustment screw - or with an IFR - to that particular point, generally in line with the manufacturer's minimum distance calculation, there simply is not enough water flow to keep it turning, hence the nozzle stops rotating and just gurgles at you.

There is an exception to the previous point, though, and that is the MP Rotator 3000 model. The minimum stated distance for the MP3000 is 22 feet. The In-stem Flow Regulator available today is able to bring the 3000 lower distance range down to 17 feet, adding another 5 feet of range to that nozzle.

Another big benefit for rotating nozzles is that some of them have tiny little screws that one must use to control the distance when not connected to an IFR part. At this moment, most of us would be thinking of Hunter's MP Rotator line. The tiny, little screw atop the rotating nozzle is recognized by most contractors as being on the troubling side. Regardless of what nozzle you have, rarely do you ever touch the screw atop the nozzle again when you have IFRs underneath. In almost all cases, all distance adjustments and most on/off control are done via the IFR even though the IFR only shuts down the sprinkler 97%-99% but not 100%. It doesn't need to shut off the sprinkler 100%; the RC or Remote Control valve needs to do that.

Additionally, IFRs oftentimes are the only method that allows for sufficient shutdown of a sprinkler with rotating nozzles AND for any and all above-grade shrub rotors. Basically, that is something you cannot do to any of them without shutting down the RC valve. This is not referring to just being able to turn off a rotating nozzle or Hunter's I-20s, Rain Bird's 5000 series or Toro's T5s or T7s for nozzle change-outs, rather it is a reference to being able to shut off the water to the rotor itself for replacement of the entire rotor or rotor nozzle for line flushing, if necessary.

However, when it comes to above-grade rotors, there is one huge benefit of IFRs that just can't be beat. The only way to reduce the spray distance of a rotor is to use a smaller nozzle or adjust the diffusion screw. When you engage the diffusion screw into the rotor stream, the distribution uniformity of the stream is affected; distribution uniformity decreases while the precipitation rate increases dramatically because the same flow rate is now distributed over a smaller area. What makes IFRs and above-grade rotors so much more efficient than just a standard shrub rotor is that you maintain distribution uniformity and reduce the flow rate at the same time. You insert the desired nozzle into the rotor, set your arc but then you set your distance with the IFR screw. You now have the freedom to adjust that distance to its maximum that the pressure and the nozzle will allow all the way down to the OFF position. Your distance can be dialed in like a guided missile. They're also very handy when servicing and/or replacing defective rotors by eliminating countless trips up and down a hillside slope. It should also be noted that ¾" IFR parts under rotors substantially reduce misting/fogging commonly seen on many hillsides in Southern California. They also prevent water hammer from damaging shrub rotor cases or the internal gear drives on slopes because each IFR helps protect the shrub rotor from incoming, high-pressure surges.

That takes us to other styles of In-stem Flow Regulators. The author assumes that future In-stem Flow Regulator products will likely have the on/off control located on the sides of other sprinkler parts in a fashion more or less similar to the existing IFRs in the marketplace. Because of that, IFRs are not confined to just being appurtenances to pop-up stems. In addition to being available presently in both male and female shrub adapters, IFRs are also available in certain plumbing fittings commonly used in irrigation. In the future, the author can imagine them in other fittings or simply in sections of pipe. The fittings in which they are presently available now are ½" and ¾" couplings – female thread at both ends, and ½" and ¾" riser extenders – female thread at one end and male thread at the other.

To be clear, the ½" couplings are necessary for use on above-grade shrub adapters where multi-stream, rotating nozzles are the nozzle of choice. The filter screens of these nozzles are a requisite to be installed with the nozzles. Until there is a different design for IFR shrub adapters, just use an IFR coupling assembled with a minimum 1" or 2" long ½" diameter nipple topped with an ordinary shrub adapter in order to accommodate the rotating nozzle and its filter screen.

Above-grade shrub adapters constitute somewhere between 10% -15% of all sprinklers in the USA. Most, of course, are found in the Sunbelt sections of the country. Pressure regulation in shrub adapters seems to be more difficult to achieve than in pop-up sprinklers where it is now becoming very common. In shrub adapter systems it is a rarity, partly because that apparatus is expensive and somewhat bulky, hence obtrusive.

But the problem with pressure regulation in shrub adapter types is completely eliminated with In-stem Flow Regulating sprinkler parts because every IFR part on the market today is pressure regulating and is simply unaffected no matter how high the pressure.

You may have noted that it has been mentioned several times that the minimum distances on certain rotating nozzles can be achieved regardless of pressure. Not knowing how future IFRs will be designed, we can only relate to those out in the marketplace now. Today's In-stem Flow Regulators simply do not care how high the pressure is. The sprinkler body may care, the RC valve may care, the sprinklers lines themselves may care. But the IFR stems do not care. It's not being said that there have not been cases where the IFR stems came apart due to high pressure, but that it has never been brought to this writer's attention. IFRs have been installed on jobs with pressures as high as 175 p.s.i. with no ill effects on the pop-up stems having been seen.

What is amazing to see is to have 100 – 110 psi or more on a given site, put a 15-foot nozzle onto an IFR pop-up, an IFR shrub adapter or an IFR coupling/shrub adapter assembly, turn on the sprinklers and then with the IFR in place see a substantial reduction in misting/fogging, then take the distance down to under 14 feet and watch as ALL of the misting and fogging totally disappears, and stays that way even as you turn the IFR screw slowly down to the off position.

An excellent visual example of this is on the author's website: watersavingsprinklers.com. Under the tab titled "Gallery & Videos", there are 11 pages of videos and pictures of the In-stem Flow Regulators in conjunction with Toro's Precision Rotating Nozzles. To get a clear picture of the ability of IFRs to override all high pressure, we suggest a visit to Page 6 and see the 'before' and 'after' videos and pictures. Page 6 features the sprinklers at the San Diego Maintenance yard of the California Transportation Dept. (Cal-Trans) where the pressure is 135 p.s.i. It is impressive to see nothing but fogging before the IFR change-out and then see it all gone after the change-out.

Because of the IFR's ability to override all high pressure and the control IFRs have over the water flow, IFRs are now being adapted to replicating many of the advantages of 'Drip' systems. It just takes the right nozzle or something that can replace the nozzle, i.e, a threaded cap with holes drilled in it, to act as an above-grade, point source watering application. Several cities and Cal-Trans, itself, are getting away from 'Drip' tubing and its accompanying maintenance and going to pin point watering devices using ½" pvc piping to bring water directly to the plant. Although more expensive, these systems are quite trouble-free, are much sturdier, and easier to service. One new model using In-stem Flow Regulation determines water flow based on the distance from the sprinkler to the plant and can be brought down to .05 gpm with the IFR. Present-day stream bubblers coupled with IFRs can accomplish many of the same benefits.

Within this lecture, 4 different testing events are noted. In truth, 18 total testing and trial events have taken place validating the water saving benefits of In-Stem Flow Regulators. Even back in 2008 before Rotating nozzles had established the foothold they have now, IFRs were proving that they were going to be a vital cog in the water conservation arena. The fourth testing event is an interesting trial called "Agoura Hills Trial No. 1". It started out on March 10, 2008 and has updates up to December 30th of that year. The trial is full of data that was confirmed by the Parks Manager for the city of Agoura Hills and led to the eventual changing out of almost every sprinkler in the city to IFRs. It is worthwhile to note that almost all the nozzles used in this trial and the subsequent city-wide change-out were 15-foot nozzles even though most of the city median strips are only 10-feet wide.

On the websites noted within, all 18 tests and trials can be seen under the sub-section called "Test Data & Water Savings Reports", which is a sub-section within the 'Think Water Conservation tab'. Directly under the Water Savings Reports, the graph referred to in the next paragraph below can be seen. Again the websites are 'watersavingsprinklers.com' or 'valvettesystems.com'.

In closing, another document is being presented which it is believed this audience will find interesting. It is called "Cost Effective Analysis – Existing Programs". It was prepared sometime in the last few years by the director of the Water Management Usage division of the Orange County (Calif) Municipal Water District, a member agency of the MWD and itself a re-seller of water to smaller water companies within Orange County, a very populous county in Southern California.

The Analysis features 30 water conservation methods/technologies/products. They are arranged in the order from least-to-most of how many dollars it takes to save one acre-foot of water – as you know, about 325,000 gallons. As it turns out, the In-stem Flow Regulator is at the top of the list in water-conservation affordability. Using IFRs costs $91.00 to save that acre-foot. No. 4 out of 30 on that list is almost double the cost of IFRs at $180 to save an acre-foot. And so we irrigators can gloat, in last place: No. 30, the least cost-effective methodology, the author's personal least favorite - the MWD's Turf Removal Program, coming in at $1,679 to save that one acre-foot of water.

Conclusion

Hence, our first conclusion is that In-stem Flow Regulating sprinklers are the proven, most cost-effective water-conservation products on the marketplace. We follow that by stating unequivocally that the key to IFRs is knowing what nozzle to use and that list is short. We can also conclude that all of the existing IFR models are pressure regulating and wasteful misting/fogging is brought totally under control. Further, because of the individual on/off control at each sprinkler, the labor and water savings to install and maintain new or existing sprinkler systems is incomparable when In-stem Flow Regulators are on the scene. Lastly, no sprinkler product on the market allows for the dialing in of the radius distance more accurately and effectively as an IFR part, which not only saves water on the merits but also reduces or eliminates run-off, which is such a wasteful practice, it is now illegal in California.

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Joe Berg, Director: Water Management Usage division of the Orange County (Calif) Municipal Water District. "Cost-Effectiveness Analysis – Existing Programs", a graph from power point presentation to various water managers in Orange County. 2014

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