Winterizing Irrigation Systems

Procedures That Avoid Problems

As managers of high-use recreational facilities realize the futility of maintaining turfgrass without irrigation, all types of systems are being installed, from the hottest regions of the country to the coldest.

Irrigation provides a reliable, consistent level of playability for turf during periods of drought or irregular rainfall. Today there are no boundaries for irrigation—and sports turf maintenance is changing as a result.

The vital role of irrigation for recreational turf has also prompted parks, schools, golf courses, universities, resorts and stadiums that already have irrigation systems to convert from manual to automatic control, add sophisticated pump stations, and upgrade sprinkler heads.

An investment in irrigation goes beyond design and installation. Regular maintenance is critical, in order to preserve the operational design of the system from year to year. Advances in controllers have eliminated much of the labor involved in operating irrigation systems. However, controllers have not replaced the human eye when it comes to troubleshooting.

Even though most of an irrigation system is out of sight, it should not be out of mind. . .especially during the winter. Not only can freezing temperatures turn water into an enemy, procedures used to remove water from the system can damage components if the turf manager is not careful. Equally delicate is the process of recharging the system in the spring.

The simplest explanation of an irrigation system is a series of interlinked containers full of water. Pressure exerted on the water at the source pushes it through pipes to valves that hold the water in chambers. Upon opening, the valve allows the pressure from the source to force water through more pipes to the sprinkler heads for distribution.

All components are designed to hold and move water within a certain pressure range and rate of flow. When conditions exceed these ranges, the pipe, fittings, valves and heads are all in danger. That is why irrigation system designers go to great lengths to select components and provide extensive specifications and details for installation.

When water freezes, it expands. If it is confined as it freezes, the water will exceed the burst strength of irrigation components, including those made of metal.

For this reason, any portion of an irrigation system below the frost line must be drained in the fall. This process is termed winterization. If properly done, it takes just a few hours and removes water from all components susceptible to freezing during the winter.

Irrigation systems, especially those in the colder regions of the country, should be installed with drainage in mind. Large systems need to be drained or blown out one section at a time. Emergency shut-off valves enable you to isolate one section from another. Pipe in each section should slope to low point(s), where drain valves are installed in gravel sumps.

A system without drains or graded pipelines is far harder to drain than one installed with drainage in mind. Yet even a system with adequate emergency gate valves, drain valves, and pitched piping will not survive poor drainage procedures.

To help avoid such costly failures, we consulted with specialists in winterizing at two irrigation manufacturers, Buckner of Fresno, CA and Weather-matic/Telsco of Dallas, TX. Their "inside information" figuratively puts you within the pipe itself.

When draining an irrigation system, consider yourself as an air mass crawling inside the pipe and pushing a ball the size of the inside diameter of the pipe to force all the water ahead of you. The water will remain in front of you until you provide an opening—a sprinkler, quick-coupling valve, or drain valve—to let the water escape from the pipe.

You must always look back to see that you have not forced any water *behind* you, as might happen in a loop pipe system, or when not starting the drainage process at the water source.

The following drainage procedure, offered by Buckner, will deal with a properly designed and installed system, and should show the need for adequate drainage provisions.

- Install two or more one-inch or larger air connections in the water-supply discharge pipe, with a gate valve between the air connection and the pipe. Air may be added through quick-coupling valves, but Weather-matic's Don Cooper cautions that air coming out of an air compressor is hot enough to damage plastic piping adjacent to the valve.
- Locate a 250-cfm or larger air compressor (two 125s will do) with a hose and fasten it to your air connections.
- Close all valves that could permit water to flow from the irrigated area back into the water source.
- Start the compressor and slowly open the air connection valve. Do not permit the air pressure to drop below 40-50 psi or the air mass will not move the water properly. On the other hand, excessively high pressure can damage pipe and fittings. Most large irrigation systems are designed to operate at approximately 120 psi at the source and 80 psi at the heads. Some pipe and fitting manufacturers will not honor warranties if their products are damaged by improper winterization.
- Select one branch of irrigation piping and open a group of valves in series nearest the water supply. The concentrated high velocity of the air will blow most of the water out of the pipe within a few minutes. When air instead of water comes out of the heads, shut off the valve to those heads. Do not permit air to blow through the heads for more than a few seconds or damage may result.

Automatic valves, whether electric or hydraulic, open quickly but close slowly. This shut-down time may range between five and 30 seconds. You want the next set of valves to open before the first set closes to prevent pressure from backing up in the system. You can instruct the controller to shut down the first set of valves and then open the next set of valves as long as you stay within the shut-down period.

Proceed from the source downstream until all of the valves have been opened, the sprinklers have discharged air, and you have reached the end of the pipe, or an emergency gate valve in the event of a loop pipe system. Operate the valves several times so air can replace the water in the operating parts of the valves.

By controlling the number of valves open, you control the pressure in the line. If the pressure drops below 40 psi, shut off several valves. Restart them when the air pressure has recovered.

It is desirable to have a drain or quick-coupling valve on both sides of an emergency shut-off valve if all of the water is to be removed from that line.

- Select the second branch of piping and repeat the previous step, from the source to the end. Continue the same process until all branches have been blown.
- At the low points in the piping, the air blew past the water, and the water has now returned to the low points by gravity. This is where the drain valves should be.

With the pipe under air pressure, *crack* the drain valve, until all air and no water

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comes out of the valve. Close the drain valve and proceed to all drains on the property, following the same closing procedure with each.

The closed drains will prevent gravel from the drain wells, and surface water from rain or a thaw, from entering the system over the winter months. Spring turn-on is also expedited by not having to make the rounds to close each drain valve.

- Repeat the procedure from the fifth step ("Select one branch," etc.) on each branch to verify that all air and no water is discharged from the sprinklers.
- Drain all gate valves, pressure-reducing valves, check valves, backflow preventers, pump volutes, pressure gauges, and piping in the pumphouse.

In closing their list of procedural pointers, the Buckner people point out that gravity drainage of an irrigation system can also be very successful. Patience is necessary—as well as a good understanding of the pipe size, water volume, and infiltration rate. However, drainage with air is usually faster and more effective for the typical installation, they advise.

Cooper, product manager and technical services manager for Weather-matic, conducts many irrigation service seminars across the United States and in Canada. "Basically, when you talk about winterization, you have to talk in terms of specific areas of the country, as procedures vary according to climate," he points out.

Discussing winterization procedures in the first of four north-to-south climatic zones, Cooper says, "In the northern part of the country, basically on a line that goes from Colorado north and Montana east through Michigan and all the way to New York, systems are winterized to a point that they're completely evacuated of water."

He continues, "Blowing out, to use the trade term, is done with an air compressor that injects air into the system till the water is completely evacuated. It's a very simple process—if done properly.

"If *not* done properly, a lot of damage can be incurred to the system," he warns, "particularly where rotary heads are used—and gear drives in particular. So let's talk for a moment about gear drives.

"The impetus for rotation comes from an impeller. Water flowing across the impeller causes it to turn. Through a gear reduction, the rotation speed of the impeller is reduced to about a two- to three-minute revolution at the nozzle. Depending on the manufacturer of the gear drive, the impeller speeds will generally be somewhere in the 1,000-rpm range."

However, he observes, if the impellers are turned on air rather than water, the rotation speed increases dramatically. The bearings that the impeller rides on are not designed for that type of operation. If the air movement is kept going through the heads for a prolonged period of time, damage can occur to the impeller bearings. A common terminology for this is "burning the bearings."

How long is too long? "The maximum cycle duration after the first head starts to blow air should be no more than 30 seconds to one minute," Cooper emphasizes. Therefore he recommends using short multiple cycles for blowing the system out. "One person should operate the controller while others observe what's going on at each head or drain valve. By using radios, the people in the field can let the person at the controller know when heads start to blow air." Another option would be to install remote-control devices to run the controllers from the field. Someone should also keep a constant watch on the air pressure.

By using multiple cycles, he explains, the impellers and impeller bearings are not stressed, as they would be with one continuous cycle of evacuation. In most small institutional systems, he advises, the system can be completely evacuated in about three cycles.

If manual drains are available, once the system has been evacuated they should be opened and left open. This procedure is recommended by Cooper for all types of irrigation equipment. Of course, these valves should be located in such a way that water does not collect at the valve opening

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and reenter the system.

Automatic drain valves can simplify matters. One example is the King Drain which closes when the pressure exceeds 10 psi. As long as the system is pressurized with water or air, the valve remains closed. It opens when the pressure drops below 10 psi to drain water that collects in low spots so freezing won't damage the pipes. A filter and back-flow valve built into the drain prevent debris from entering the system. These valves allow for winter drainage and eliminate the process of opening and closing drain valves in the fall and spring.

Gard Craw, spokesman for Hunter Industries, a manufacturer of gear-drive heads, says that pressure should be watched at all times during blow-out. "Some people think that if they raise the pressure the job gets done faster," says Craw. "All you need is about 40 psi and you shouldn't go above that."

"As we travel further south across the country," Cooper continues, "winterization becomes simply a case of draining the mains and laterals through the use of drain valves.

"The one thing demanding particular attention in these instances would be any backflow-prevention device set above grade—above ground level," Cooper advises. "Depending on the winter's severity in your area, special attention will need to be paid to these units to make sure they are drained.

"As we progress further south, winterization may simply consist of assuring that the system does not operate during an extreme cold snap. Where system operation is allowed during the winter, one of the prime methods to prevent watering during such a cold snap would be the use of a freeze-stat. This item is simply a temperature gauge with a switch, or else a temperature-sensitive switch. It would preclude system operation once the temperature drops to 40 degrees or less."

These items can be purchased preset at a specific temperature, or they can be bought with the temperature as an adjustable feature.

"As we proceed south, basically to the Caribbean, the last temperature extreme would require virtually no winterization," Cooper continues. "In Florida they very seldom winterize. Even here, in certain parts of Texas, we seldom winterize. This is particularly true of south Texas.

"So basically there are four strata of winterization within the United States. Most of the winterization provisions are made at installation by the contractor. By this we mean that if you're going to use air evacuation, an entryway into the system has to be 'plumped' into that system during installation.

"One thing is mandatory when installing automatic drains: They must be installed at the low point of the line being drained, to assure that complete drainage will occur. Automatic drains need good gravel sumps.

"Manual drains also need good gravel sumps—and access to manual drains needs to be built into the system at the time of installation, with attention being paid to grade changes," says Cooper.

"One more place where caution needs to be used is this: When evacuating with air, do not over-pressure the irrigation system. Too often, during evacuation of the system, people pay more attention to speed than to the care of the system itself."

When this happens, Cooper emphasizes, the problems that occur during turn-on or restart the following spring can be tremendous, due to damaged equipment—not only the irrigation equipment, such as sprinkler heads and valves, but damage to the piping itself.

"The reason I make this statement is that, unlike water, air is tremendously compressive," he explains. "And, as a result, pressure surges two or three times that of the originating pressure can be built up in the system. In most cases, an irrigation system is not designed to handle these pressures."

Cooper adds, "One of the main concerns most service people have, as far as winterizing an irrigation system is concerned, is 'What do we do with the controller?'

"As a rule of thumb, it is best if the controller is kept operating. Irrigation controllers are designed to be operated 24 hours a day, 365 days a year. By operating the controllers, the operating components—gears, bushings, bearings, etc.—in electro-mechanical controllers are kept from obtaining a 'set.'

"In electronic controllers, the circuit components are kept active and fresh, and the surge protection is kept functional," says Cooper. "Additionally, the heat generated by the transformer helps to keep the condensation that would otherwise occur to a minimum.

"The main point to remember is that the valves must be precluded from operating. Most controllers have a switch that breaks the output voltage to the valves. It is not advisable to operate the solenoids on the valves dry—that is, with no water in the valve."

Some irrigation systems have moisture-sensing equipment installed above ground that is used to preclude automatic operation if enough rainfall occurs. "When winterizing," Cooper warns, "remember to protect these devices in addition to the remainder of the system. If these sensors have collected moisture and a freeze occurs, they are more than likely going to be damaged."

All the precautions that are vital to winterizing are just as important when a drained system is recharged. Water flows considerably faster in an empty pipe than in one full of water. You don't just turn on the pump and start opening valves. The system should be refilled slowly, in order to get all the air out of the lines first.

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"When a pipe is full of water the design velocity should be four to five feet per second," explains Cooper. "In an empty pipe, water can reach a velocity of up to 13 feet per second. When the pipe becomes full and the water velocity is suddenly reduced to design velocity, a pressure surge of up to three to four times static pressure can be generated at the sprinkler head. Water hammer, caused when the velocity of the water is suddenly slowed, can burst heads, pipe, and fittings, causing severe damage to an irrigation system."

Cooper suggests turf managers with pump stations use just the jockey pump to charge the system—and keep as many valves open as possible. "It may take eight hours or more to charge a golf course irrigation system, but the worst possible thing you can do is rush it," he warns.

He strongly advises that large irrigation systems include sufficient filters to remove sand and debris. Such material can seriously harm components when the system is winterized. Whenever a pipe is repaired, the system should be flushed by removing downstream heads to remove any dirt, glue or debris that may have entered the system.

Cooper prefers to keep drain valves open during the winter, in order to allow moisture entering the system from melting snow and rain to drain out.

"It's not unusual for irrigation heads to be under water or hidden beneath snow during the winter," he remarks. "Some of that water is going to drain into the heads and down to the valves and pipe. While a portion of the water will evaporate, the rest needs someplace to go. Keeping the drain valves open, but protected, will get rid of the water."

Winterizing is something that turf managers should keep in mind throughout the year. There is more to irrigation maintenance than meets the eye, and it's what you don't see that can hurt you more than what you can see.

"This may require a little extra effort in the fall," Cooper admits, "but it's better than replacing damaged components in the spring."