Maintaining Your Micro-Irrigation System

As with any other piece of farming equipment, your irrigation system must be properly operated and maintained to obtain the desired results, which in this case is the uniform application of water and nutrients to your crop. This is accomplished by keeping the emission devices, the sprinklers or drippers, clean and flowing uniformly. It is important, therefore, to have an understanding of the various factors that affect the performance of the emission device, and the equipment that is placed along the way between the water source and the emitter to modify the effects of these factors.

Perhaps the most basic factor affecting your system is gravity. Water tends to flow downhill. In areas where your field is not downhill from your water source, you will find a piece of equipment to modify this. A **pump**. All pumps require periodic lubrication and maintenance, and are subject to wear. Periodic pump testing, every five years or so, more often if you are pumping sand along with the water, will insure that your pump wear is not wasting your dollars through inefficient use.

A second type of device to modify the effects of gravity is the **pressure control valve**. All emission devices are designed to operate within a pressure range, often referred to as the pressure *window* or *envelope*, and it is the function of the pressure control valve to maintain this envelope. Many emitters are classified as *pressure compensating*, which means their envelope is large, say 5 to 55 psi. Oftentimes the irrigation system, because of gravity and pump design, will always operate within this range, so no pressure control valve is needed. In non-pressure compensating systems, the designs may call for a pressure envelope as narrow as plus or minus 15% of the operating pressure, (17 to 23 psi for a 20 psi system.) This is where we may find one or more control valves. These valves vary in design, some to reduce pressure downstream, some to vent off excessive pressure upstream, but all share the need for inspection and calibration at least once per year.

The third device used to modify the effects of gravity is the **vacuum relief valve**. When you turn off your system by closing a valve or shutting off the pump, the water that remains in the system will flow downhill to the lowest points. The water vacating the high points leaves a vacuum, which cause emitters in this region to suck in air, water, dirt or whatever else is handy. In extreme cases it can cause your PVC mainlines to collapse. The vacuum relief valve is placed in these high spots, and allows air to rapidly fill this vacuum, before damage occurs. These **vents** are also used as an 'escape hatch' for air when you start your system. They typically utilize a ball or float assembly and a seal as a closure mechanism, and need periodic inspection to insure that no foreign object is caught in them, or that they are not stuck in the open or shut position.

In addition to the effects of gravity and the devices used to modify those effects, we have the factors concerning the **things that are carried in the water**. These are the factors we normally deal with in maintaining a drip irrigation system, because they are chronic factors. They *build up over time*, gradually clogging emitters and affecting the ability of the emission devices to apply the water and nutrients evenly. Many times the system will have operated with no apparent problems for several seasons, until the chronic build up of foreign matter in the emitters reaches a critical mass and demands your attention. A good analogy would be operating your new tractor without any servicing at all. How many years would it run? A couple three?

The 'stuff' that is carried in the water, besides H_2O, that can cause these chronic plugging effects in the emission device, can be placed into three main groups for ease of discussion: dissolved solids, or salts; organic particles, which are things that are alive or were very recently alive; and inorganic particles, such as clay, silt and sand.

The **dissolved salts** that are carried into your irrigation system and your field are perhaps the most difficult to comprehend and deal with. Because they are dissolved, we are unable to filter them out. So where's the problem? Why don't they pass through the emitters, as they did through the filter? All dissolved salts are in what is termed an *equilibrium* in solution. This balance between being dissolved and being precipitated is constantly changing, depending on the physical and chemical conditions of the system. The **physical parameters** affecting whether or not a salt stays in solution are temperature, pressure and concentration. When we observe what happens to the irrigation water from when it enters a drip system, to when it trickles out of the emitter, we find it changes pressure, temperature and concentration, with evaporation at the emitter. Any one of these factors can cause the balance to tip towards precipitation. The **chemical parameters** that affect the equilibrium of salts in solution include pH and a series of reaction mechanisms that are best left to the chemists. Simply put, things like atmospheric oxygen or certain fertilizers, when mixed with the irrigation water, can cause salts to precipitate out *downstream* of the filters, and get hung up in the emitter. Fortunately, all of these reactions are predictable, and a water quality analysis, coupled with a competent interpretation, can help avoid the effects of salt precipitation with the addition of appropriate water conditioners, such as anti-scaling compounds, acids or sequestering agents.

The second group of contaminants, the **organics**, make up the living portion of the ecosystem that exists in all irrigation systems. These are either living critters that feed on others, or dead critters that serve as the living critters' next meal. If algae, fish and invertebrates the are in the source water, we can generally do a pretty good job removing them with a filter of some sort. What tend to give us problems are the **bacteria** that grow downstream of the filters, feeding off the dissolved nutrients and minute particles that slip past our filters. If allowed to establish themselves in the hoses, these bacteria grow and serve as an anchor for silt, which serves as a food source for more bacteria. This can lead to logarithmic colonization of bacteria, which results in the chronic clogging symptoms we referred to earlier: "The system went along just fine for three years, then all of a sudden, everything plugged up! We did everything the same. What happened?" We reached 'critical mass'. To prevent this scenario, we need to periodically, or continually, add a biocide, such as **chlorine**, bromine, ozone, etc., to keep the bacterial populations at a minimum. To be effective, we may need to lower the pH of the water, allowing the biocide to be more reactive. Your water analysis interpretation will help predict this. **Flushing hose ends** to remove the accumulated smorgasbord of organics and silts also serves to keep our ecosystem balanced in our favor. By monitoring the flush water, we can easily determine if we are flushing with the appropriate frequency. Run the flush into a clear jar, and hold it up to the light. If it is crystal clear, no need to flush. If it looks like Chinese egg drop soup, we had better tighten up the program.

The third group of contaminants is the **inorganic silts and sand**. The degree to which we need to modify their presence in the system is dictated by our emission device. Certain devices, such as very low volume micro sprinklers, require a greater degree of filtration because of the size of their orifice or hydraulic pathway, than would be required by a high volume tortuous path emitter. Your filter was then selected as an appropriate device to remove all of the solid contaminates, both organic and inorganic, which would effect the performance of the emitter. Consideration should also have been given to the source of the irrigation water: Is it from a canal, full of algae, but no sand?; Is it from a well with some fine sand, but no algae? Hopefully, all of the right questions were asked and answered, and we are now dealing with an appropriate filter application. So, how do we maintain it?

All types of filters, whether they be screens, cyclones, disks or media beds, require periodic inspection and servicing. **Hydrocyclones**, or sand separators, which typically have no moving parts, require periodic inspection to insure that the collected sand is being purged satisfactorily, and the epoxy coating (if applicable) is intact. Simple **screen filters** should be opened and the screens visually inspected for wear, tears and possible blockage with organics, silts and precipitates. The same is true for **disk-type**

filters. If any of these are present, careful cleaning of the filter element should be performed, and the element replaced. Screen and disk filters are also available with automated back-flushing devices. These devices are intended to frequently clean the element, thus saving a great deal of labor. These devices are not intended to replace periodic visual inspection of the element for wear or persistent contaminates. The back-flushing devices, usually a set of hydraulic valves, solenoids and perhaps rotating vacuum devices, may require periodic servicing and lubrication. Nearly all will have a **small hydraulic command water filter** to prevent blockage of the solenoid ports and valve control chambers, and this filter needs to be manually cleaned periodically.

The final style of filter commonly used in agricultural applications is the **media bed filter**. Because of its wide use and the fact that it is a *dynamic* filter,(it fluidizes and re-integrates itself every flush cycle), it requires special attention. A media system is designed to entrap organic and inorganic particles in a bed of sand. A fine, crushed rock, such as #20 silica, which has jagged edges to capture the contaminates is recommended for the systems with drip emitters that have small passageways, and are susceptible to clogging. To effectively trap the contaminates, the flow through a given tank should be within a specified range. This varies between manufacturers, but a typical 48" tank would be in the range of 200 and 300 gallons per minute (gpm). Below the lower flow rates, contaminates tend to infiltrate deeper into the media bed. Flows higher than the recommended upper rates can lead to coning and channelization. **Coning** is where there is a cone of media sand formed in the center of the tank, and is caused by the excessive downward flows striking the diffusion plate, being deflected towards the walls of the tanks and scouring the media sand away from the walls of the tank, depositing it towards the center of the tank (underneath the diffusion plate). **Channelization** is where areas of exposed base gravel or the underdrain are visible on the surface of the media, allowing water to pass through the tanks without contacting the filtration sand, compromising filtration, and potentially plugging the underdrain. This can be caused by excessive downward flows in the coning process, and also by excessive upward flows, when the tank is being back-flushed. When you open the tank and peek in, and see signs of either channelization or coning, you are possibly jeopardizing your system through poor filtration. Consult your dealer or the manufacturer to remedy this condition. Oftentimes the simple addition of a pressure sustaining valve will correct the problem.

To effectively back-flush a tank, the flow is reversed through the tank, and the media sand is lifted and separated, in a fluidization process that releases the previously entrapped contaminates. **The rate of back-flush flow is critical**...enough to lift the media, while passing just a minor amount of sand out through the discharge manifold.

The recommended back-flush flow rate for a 48" tank is around 200 gpm, depending again on make and model.

Setting the back-flush flow control valve, usually a 3" or 4" brass gate valve, to discharge the proper amount of water, *e.g.* 200 gpm, requires a visual and tactile inspection of the discharge water. While a tank is back-flushing, monitor the discharge stream with a nylon stocking (100 mesh), or your hand, until only a very small amount of media sand is being discharged. You will normally lose 1 to 2 sacks of media (1 to 2" in a 48" tank) per season. A 3" gate valve is open approximately 1 1/2 to 2 turns at 60 psi, a 4" gate valve approximately half of that. It is important to note that if the operating pressure varies for any reason, such as irrigating blocks of widely varying size, the gate valve setting will not be correct, as flow through any given orifice, (the partially opened gate valve), varies with pressure. Ideally, a pressure sustaining value would be installed downstream of the gate valve to regulate flow. This is an expensive option, but it does work well if you routinely irrigate blocks of differing sizes.

It is now becoming rather apparent that **frequent visual inspection of the media sand** is necessary to insure that adequate filtration is taking place. "Frequent" for a new system is once per month. Once you have a feel for what is going on during filtration and back-flushing, you may choose to inspect the tanks annually. Remember, we should be losing one or two bags of media every season, so we need to replace that. When we look in through the top port, we should see a level surface of clean sand. We then dig down through the media, to confirm that it is uniform all the way through to the gravel bed, or underdrain structure. Sometimes channelization will cause zones which are not being properly fluidized during back-flush, and you will find clay balls or silty stratifications. A not too uncommon occurrence is contamination of the media with foreign sand or turbine oil from the well. Any of these conditions would indicate a need to replace the media.

The first step in **replacing the media** is to remove the existing sand either by hand, or hopefully with a pressure hose through a flushing port near the bottom of the tank. This allows you to visually inspect the underdrain, the device that is designed to evenly distribute the flow through the tank and prevent the media sand from passing through the tank into the emitters. An inexpensive 'insurance policy' is to install a back up screen downstream of the media tanks to catch the media, in the event of an underdrain failure. Typically, however, the underdrain is your last protection between the media sand and total disaster. Inspect it carefully!

To determine what grade(s) of media to place in the tank, you should consult the manufacturer. A typical example is as follows: When installing new gravel and media sand, the gravel must be first thoroughly washed, by rinsing it in a sloping pick-up bed for example. Six hundred pounds of washed gravel per 48" tank will cover the underdrains by a few inches, allow for even back-flush diffusion and isolate the fine media sand from the underdrain screens. The 1300 lbs. of #20 crushed silica is then added, and it should fill a 48" tank up to 'fill line', typically near the top weld. This new sand contains lots of fine dust particles, and the new media bed must be rinsed carefully and thoroughly before operation. This prevents the fine particles from plugging the underdrain screens. To accomplish this, we must close the field valve(s) to isolate the filters from the field, and then flush one tank at a time. The only flow through the system should be the 200 gpm required to flush the one tank. This insures a minimal flow through the other tank(s), thereby reducing the potential of underdrain contamination by the unwashed sand. On some systems this can be challenging, because of the excessive pressures developed by the pump. Each system will be slightly different, but the idea is to minimize system flow during the initial media cleaning process. It takes about 2 1/2 to 3 minutes per tank to sufficiently rinse a new sand load. The effectiveness of the rinse must be evaluated through observation of the discharge. The ability to **inspect the back-flush water** both visually and with touch is critically important to insure proper filtration, and hence, system performance. This simple, inexpensive monitoring system is often absent, and should be installed in every media tank system.

As a final note on system maintenance, all of the manufacturers of your system components are eager and most willing to insure that their equipment is functioning properly. All have trained technicians a phone call away. If you have any questions regarding the operation or maintenance of your equipment, the manufacturer will be pleased to address those questions. It is in their best interest, as it is in yours.

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