KEY CONSIDERATIONS FOR A SUCCESSFUL SUBSURFACE DRIP IRRIGATION (SDI) SYSTEM

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INTRODUCTION

Subsurface drip irrigation (SDI) systems are currently being used on about 15,000 acres in Kansas. Research studies at the NW Kansas Research and Extension Center of Kansas State University begin in 1989 and have indicated that these systems can be efficient, long-lived, and adaptable for irrigated corn production in western Kansas. This adaptability is likely extended to any of the deep-rooted irrigated crops grown in the region. Many producers have had successful experiences with SDI systems; however most have had to experience at least some minor technical difficulties during the adoption process. However, a few systems have been abandoned or failed after a short use period due to problems associated with either inadequate design, inadequate management or combination of both.

Both research studies and on-farm producers experience indicate SDI systems can result in high yielding crop and water-conserving production practices, but only if the systems are properly designed, installed, operated and maintained. SDI systems in the High Plains must also have long life to be economically viable when used to produce the relative low value field crops common to the region. Design and management are closely linked in a successful SDI system. A system that is not properly designed and installed, will be difficult to operate and maintain and most likely will not achieve high irrigation water application uniformity and efficiency goals. However, a correctly designed and installed SDI system will not perform well, if not properly operated and is destined for early failure without proper maintenance. This paper will review important considerations for a successful SDI system.

IMPORTANT SDI SYSTEM CONSIDERATIONS

Design considerations must account for field and soil characteristics, water quality, well capabilities, desired crops, production systems, and producer goals. It is difficult to separate design and management considerations into distinct issues as the system design should consider management restraints and goals. However, there are certain basic features that should be a part of all SDI systems, as shown in Figure 1. Omission of any of these minimum components by a designer should raise a red flag to the producer and will likely seriously undermine the ability of the producer to operate and maintain the system in an efficient manner for a long period of time. Minimum SDI system components should not be sacrificed as a design and installation cost-cutting measure. If minimum SDI components cannot be included as part of the system, serious consideration should be given to an alternative type of irrigation system or remaining as a dryland production system.

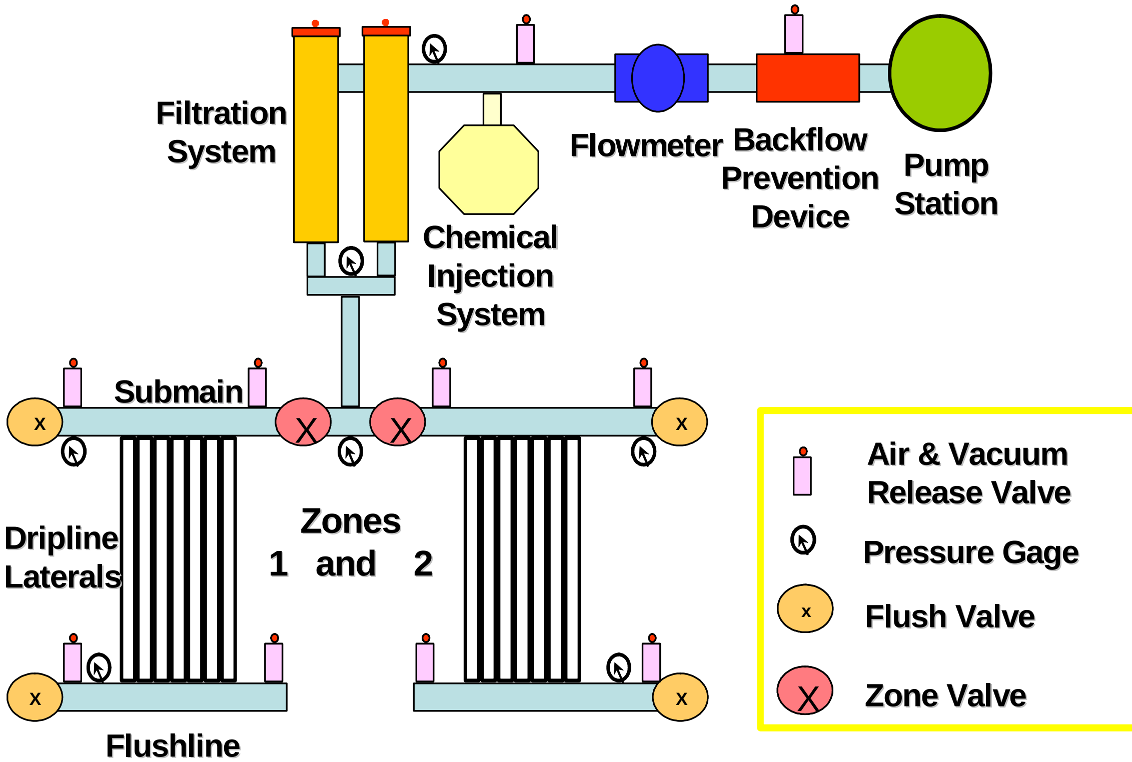

Figure 1. Schematic of Subsurface Drip Irrigation (SDI) System. (Components are not to scale) K-State Research and Extension Bulletin MF-2576, Subsurface Drip Irrigation (SDI) Component: Minimum Requirements

DISTRIBUTION COMPONENTS

The water distribution components of an SDI system are the pumping station, the main, submains and dripline laterals. The size requirements for the mains and submains would be similar to the needs for underground service pipe to center pivots or main pipelines for surface flood systems. Size is determined by the flow rate and acceptable friction loss within the pipe. In general, the flow rate and acceptable friction loss determines the size (diameter) for a given dripline lateral length. Another factor is the land slope. Theoretically, but totally unwise, a drip system could be only a combination of pumping plant, distribution pipelines and dripline laterals. However, as an underground system, there would be no method to monitor system performance and the system would not have any protection from clogging. Clogging of dripline emitters is the primary reason for SDI system failure.

MANAGEMENT COMPONENTS

The remaining components outlined in Figure 1, are primarily components that allow the producers to protect the SDI system, monitor its performance, and if desired, provide additional nutrients or chemicals for crop production. The backflow preventive device is a requirement to protect the source water from accidental contamination should a backflow occur.

The flow meter and pressure gauges are essentially the operational feedback cues to the manager. In SDI systems, all water application is underground. In most properly installed and operated systems, no surface wetting occurs during irrigation, so no visual cues are available to the manager concerning the system operating characteristics. The pressure gauges at the control valve at each zone, allows the proper entry pressure to dripline laterals to be set. Decreasing flow and/or increasing pressure can indicate clogging is occurring. Increasing flow with decreasing pressure can indicate a major line leak. The pressure gauges at the distal ends of the dripline laterals are especially important in establishing the baseline performance characteristics of the SDI system.

The heart of the protection system for the driplines is the filtration system. The type of filtration system needed will depend on the quality characteristics of the irrigation water. In general, clogging hazards are classified as physical, biological or chemical. The Figure 1 illustration of the filtration system depicts a pair of screen filters. In some cases, the filtration system may be a combination of components. For example, a well that produces a lot of sand may have a sand separator in advance of the main filter. Sand particles in the water would represent a physical clogging hazard. Other types of filters used are sand media and disc filters.

Biological hazards are living organisms or life by-products that can clog emitters. Surface water supplies may require several layers of screen barriers at the intake site to remove large debris and organic matter. Another type of filter is a sand media filter, which is a large tank of specially-graded sand and is well-suited for surface water sources. Wells that produce high iron content water, can also be vulnerable to biological clogging hazards, such as when iron bacteria have infested a well. Control of bacterial growths generally requires water treatment, in addition to filtration.

Chemical clogging hazards are associated with the chemical composition or quality of the irrigation water. As water is pulled from a well and introduced to the distribution system, chemical reactions can occur due to changes in temperature, pressure, air exposure, or the introduction of other materials into the water stream. If precipitants form, they can clog the emitters.

The chemical injection system can either be a part of the filtration system or could be used as part of the crop production management plan to allow the injection of nutrients or chemicals to enhance plant growth or yield.

The injection system in Figure 1 is depicted as a single injection point, located upstream of the main filter. In many cases, there might be two injection systems. In other cases, there may be a need for an injection point downstream from the filter location.

The injection system, when it is a part of the protection system for the SDI system, can be used to inject a variety of materials to accomplish various goals. The most commonly injected material is chlorine, which helps to disinfect the system and minimizes the risk of clogging associated with biological organisms. Acid injection can also be injected to affect the chemical characteristic of the irrigation water. For example, high pH water may have a high clogging hazard due to a mineral dropping out of solution in the dripline after the filter. The addition of a small amount of acid to lower the pH to slightly acid might prevent this hazard from occurring.

PRODUCER RESPONSIBILITIES

As with most investments, the decision as to whether the investment would be sound lies with the investor. Good judgments generally require a good understanding of the fundamentals of the particular opportunity and/or the recommendations from a trusted and proven expert. While the microirrigation (drip) industry dates back over 40 years now and its application in Kansas as SDI has been researched since 1989, a network of industry support is still in the early development phase in the High Plains region. Individuals considering SDI should spend time to determine if SDI is a viable systems option for their situation. They might ask themselves:

What things should I consider before I purchase a SDI system?

1. Educate yourself before contacting a service provider or salesperson by
   a. Seeking out university and other educational resources. Good places to start are the K-State SDI website at www.oznet.ksu.edu/sdi and the Microirrigation forum at www.microirrigationforum.com. Read the literature or websites of companies as well.
   b. Review minimum recommended design components as recommended by K-State. http://www.oznet.ksu.edu/sdi/Reports/2003/mf2576.pdf
   c. Visit other producer sites that have installed and used SDI. Most current producers are willing to show them to others.

2. Interview at least two companies.
   a. Ask them for references, credentials (training and experience) and sites (including the names of contacts or references) of other completed systems.
   b. Ask questions about design and operation details. Pay particular attention if the minimum SDI system components are not met. If not, ask why? System longevity is a critical factor for economical use of SDI.
   c. Ask companies to clearly define their role and responsibility in designing, installing and servicing the system. Determine what guarantees are provided.

3. Obtain an independent review of the design by an individual that is not associated with sales. This adds cost but should be minor compared to the total cost of a large SDI system.

CONCLUSIONS

SDI can be a viable irrigation system option, but should be carefully considered by producers before any financial investment is made.

OTHER AVAILABLE INFORMATION

The above discussion is a very brief summary from materials available through K-State. The SDI related bulletins and irrigation related websites are listed below.

MF-2361 *Filtration and Maintenance Considerations for Subsurface Drip Irrigation (SDI) Systems*
http://www.oznet.ksu.edu/sdi/Reports/2003/mf2361.pdf

MF-2576 *Subsurface Drip Irrigation (SDI) Components: Minimum Requirements* *http://www.oznet.ksu.edu/sdi/Reports/2003/mf2576.pdf*

MF-2578 *Design Considerations for Subsurface Drip Irrigation* *http://www.oznet.ksu.edu/sdi/Reports/2003/mf2578.pdf*

MF-2590 *Management Consideration for Operating a Subsurface Drip Irrigation System* *http://www.oznet.ksu.edu/sdi/Reports/2003/MF2590.pdf*

MF-2575 *Water Quality Assessment Guidelines for Subsurface Drip Irrigation* *http://www.oznet.ksu.edu/sdi/Reports/2003/mf2575.pdf*

MF 2589 *Shock Chlorination Treatment for Irrigation Wells* *http://www.oznet.ksu.edu/sdi/Reports/2003/mf2589.pdf*

Related K-State Research and Extension Irrigation Websites:

Subsurface Drip Irrigation
www.oznet.ksu.edu/sdi

General Irrigation
www.oznet.ksu.edu/irrigate

Mobile Irrigation Lab
www.oznet.ksu.edu/mil

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