Agricultural Chemigation
System Safety
Agricultural Chemigation
System Safety

Larry Schwankl
Irrigation Specialist, UC Coop. Extension

Thanks to Mike Howard of Bayer Corp. and Will Suckow of UC Communication Services
Chemigation

Chemigation is the application of a chemical through the irrigation system by mixing the chemical with the irrigation water.
Chemigation of labeled chemicals

The label specifies the “Required System Safety Devices” in the “USE IN CHEMIGATION SYSTEMS” section.

EPA, CA Dept. of Pesticide Regulation (DPR), and the County Ag Commissioners are all involved in setting and enforcing chemigation standards.
Chemigation Safety

This presentation concentrates on:

- Chemigation hardware and safety issues
- It does not address other chemigation management issues
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”.

Purpose: No water movement back to the water source
Single Check Valve
Positive Displacement Pump Injection System

- Irrigation controller
- Electrically interlocked control panel
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- Positive displacement pump injector interlocked with irrigation pump
- Chemical supply tank
- Filter
- Check valve
- To irrigation system
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”. (No water movement back to the water source).

2. “Automatic, quick-closing check valve to prevent backflow toward the injection pump”.

Purpose: prevent overflow of the storage tank
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”. (No water movement back to the water source)

2. “Automatic, quick-closing check valve to prevent backflow toward the injection pump”. (Do not want to overflow the storage tank)

3. “Normally-closed solenoid valve on intake side of injection pump, interlocked to pump”.

Purpose: Prevent flow of chemical to the injector if the pump is shut down.
Positive Displacement Pump Injection System

- Irrigation controller
- Electrically interlocked control panel
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- Chemical supply tank
- Positive displacement pump injector interlocked with irrigation pump
- Solenoid valve (normally closed)
- Check valve
- To irrigation system
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”. (No water movement back to the water source)

2. “Automatic, quick-closing check valve to prevent backflow toward the injection pump”. (Do not want to overflow the storage tank)

3. “ Normally-closed solenoid valve on intake side of injection pump, interlocked to pump”. (No flow of chemical to injector if the pump is shut down)

4. “The injection pump is interlocked to the irrigation pump”.

Purpose: No injection will occur without water running.
Positive Displacement Pump Injection System

Irrigation controller

Electrically interlocked control panel

Positive displacement pump injector interlocked with irrigation pump

Solenoid valve (normally closed)

Filter

Check valve

To irrigation system

Electric motor and pump

Single check valve with vacuum relief and low pressure drain

Shutoff valve

Pressure switch
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”. (No water movement back to the water source)
2. “Automatic, quick-closing check valve to prevent backflow toward the injection pump”. (Do not want to overflow the storage tank)
3. “Normally-closed solenoid valve on intake side of injection pump, interlocked to pump”. (No flow of chemical to injector if the pump is shut down)
4. “The injection pump is interlocked to the irrigation pump”. (No injection will occur without water running)
5. “Pressure switch in the irrigation line which will stop the irrigation pump”.

Purpose: Stops irrigation and injection if there is a break in the irrigation line.
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”. (No water movement back to the water source)
2. “Automatic, quick-closing check valve to prevent backflow toward the injection pump”. (Do not want to overflow the storage tank)
3. “Normally-closed solenoid valve on intake side of injection pump, interlocked to pump”. (No flow of chemical to injector if the pump is shut down)
4. “The injection pump is interlocked to the irrigation pump”. (No injection will occur without water running)
5. “Pressure switch in the irrigation line which will stop the irrigation pump”. (Stops irrigation and injection if there is a break in the irrigation line)
6. “Use a metering pump (positive displacement pump for injection. Positive displacement pumps include piston/cylinder pumps and diaphragm pumps”.

Positive Displacement Pump Injection System

Irrigation controller

Electrically interlocked control panel

Positive displacement pump injector interlocked with irrigation pump

Solenoid valve (normally closed)

Filter

Check valve

Electric motor and pump

Single check valve with vacuum relief and low pressure drain

Shutoff valve

Pressure switch

To irrigation system

Chemical supply tank
Positive Displacement Pump - Piston / Cylinder
Positive Displacement Pump - Diaphragm Pump
Chemigation Safety

- Some regulations require a double check valve system to provide safety redundancy.
Double Check Valve, Positive Displacement Pump Injection System

- Irrigation controller
- Positive displacement pump injector interlocked with irrigation pump
- Chemical supply tank
- Electric motor and pump
- Double check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- Filter
- Check valve
- To irrigation system
Double Check Valve
Chemigation Safety

Some locales even require a *Pressure Reducing Backflow Prevention Valve*. These are the backflow prevention valves used on urban water systems and they are extremely expensive.
Pressure Reducing Backflow Prevention Valve
Chemigation Safety

There are also approved alternatives to the label’s list of Required System Safety Devices. They include:
Chemigation Safety

Alternative devices:

Replacing the normally-closed solenoid valve on the injection pump line with a “functional spring-loaded check valve with a minimum of 10 psi cracking pressure”.

“This single device can substitute for both the solenoid-operated valve and the automatic, quick-closing check valve in the pesticide line”.

Positive Displacement Pump Injection System

- Chemical supply tank
- Irrigation controller
- Positive displacement pump injector interlocked with irrigation pump
- Electrically interlocked control panel
- Solenoid valve (normally closed)
- Filter
- Check valve
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- To irrigation system
Positive Displacement Pump
Injection System (alternative device 1)
Spring loaded check valve on intake side of injection pump

Irrigation controller
Electrically interlocked control panel
Positive displacement pump injector interlocked with irrigation pump
Spring-loaded check valve
Chemical supply tank
Filter
Electric motor and pump
Single check valve with vacuum relief and low pressure drain
Shutoff valve
Pressure switch
To irrigation system
Chemigation Safety

Alternative devices:

Replacing the normally-closed solenoid valve on the injection pump line with a “functional normally-closed, hydraulically operated check valve’.

This valve would only open when the main water line is adequately pressurized.
Positive Displacement Pump Injection System

- Irrigation controller
- Electrically interlocked control panel
- Positive displacement pump injector interlocked with irrigation pump
- Chemical supply tank
- Filter
- Solenoid valve (normally closed)
- Check valve
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- Electric motor and pump
- To irrigation system
Positive Displacement Pump
Injection System (alternative device 2)
Hydraulically-operated valve on intake side of injection pump

Irrigation controller

Electrically interlocked control panel

Positive displacement pump injector interlocked with irrigation pump

Hydraulically-operated valve (normally closed)

Filter

Chemical supply tank

Electric motor and pump

Single check valve with vacuum relief and low pressure drain

Shutoff valve

Pressure switch

To irrigation system
Chemigation Safety

Alternative devices:

Replacing the normally-closed solenoid valve on the injection pump line with a “functional vacuum relief valve located in the pesticide injection line between the positive displacement pump and the check. This valve must be elevated at least 12 inches above the highest fluid level in the pesticide supply tank and the highest point in the injection line.”
Positive Displacement Pump Injection System

- Chemical supply tank
- Positive displacement pump injector interlocked with irrigation pump
- Filter
- Solenoid valve (normally closed)
- Check valve
- Electrically interlocked control panel
- Irrigation controller
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- To irrigation system
Positive Displacement Pump Injection System (alternative device 3)

Vacuum-relief valve located on gooseneck (12" above highest fluid level in supply tank).
Chemigation Safety

Alternative devices:

Replacing the positive displacement injection pump with “a venturi system inserted directly into the main water line. The line from the pesticide supply tank to the venturi must contain a quick-closing check valve. This supply line must also contain either a (1) normally-closed, hydraulically operated valve, or (2) a normally-closed solenoid valve, interlocked to the irrigation pump”.

Venturi Injector:
Positive Displacement Pump Injection System

- Irrigation controller
- Electrically interlocked control panel
- Positive displacement pump injector interlocked with irrigation pump
- Solenoid valve (normally closed)
- Filter
- Check valve
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- To irrigation system
- Chemical supply tank
Inline Venturi Injector System 1

Chemical supply tank

Irrigation controller

Electric motor and pump

Electrically interlocked control panel

Filter

Check valve

Solenoid valve (normally closed)

Single check valve with vacuum relief and low pressure drain

Shutoff valve

Venturi

To irrigation system
Chemigation Safety

Alternative devices:

Replacing the positive displacement injection pump with "a bypass venturi injector". The same requirements for valves on the intake line to the venturi injector hold for both the inline venturi injector system and for the bypass venturi injector system.
Positive Displacement Pump Injection System

- Irrigation controller
- Electrically interlocked control panel
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Shutoff valve
- Pressure switch
- Chemical supply tank
- Positive displacement pump injector interlocked with irrigation pump
- Solenoid valve (normally closed)
- Filter
- Check valve
- To irrigation system
Venturi Injector - Bypass Across a Pressure Drop
Venturi Injector

- The bypass venturi injector must be plumbed across a pressure drop in order to work.

- There is approximately a 20% pressure loss across the venturi.

- The venturi injector can sometimes be difficult to adjust for a constant injection rate, especially if the irrigation system pressure is fluctuating or changes (different irrigation blocks being irrigated).
Chemigation Safety

Alternative devices:

Replacing the positive displacement injection pump with “a bypass venturi injector”. Instead of the valves in the line from the pesticide tank to the venturi, install a check valve upstream of the venturi and either a normally closed solenoid or a normally closed hydraulically operated valve downstream of the venturi injector.
Bypass Venturi Injector System 3

- Chemical supply tank
- Irrigation controller
- Electrically interlocked control panel
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Gate or butterfly valve
- Pressure gauge
- Venturi
- Check valve
- Solenoid valve (normally closed)
- Gate valve

To irrigation system
Bypass Venturi Injector System 4

- Chemical supply tank
- Irrigation controller
- Electrical control panel
- Electric motor and pump
- Filter
- Check valve
- Hydraulically-operated valve (normally closed)
- Pressure gauge
- Venturi
- Gate or butterfly valve
- Single check valve with vacuum relief and low pressure drain
- Gate valve
- To irrigation system
Chemigation Safety

Alternative devices:

The bypass venturi system can also be installed using a *booster pump*.

With a booster pump venturi system, the venturi does not need to be installed across a pressure drop.

With a booster pump system, the venturi system is more easily controlled and not as sensitive to changes in the irrigation system pressure.
Venturi Injector - Bypass with a Booster Pump
Venturi Booster Pump Injection System

**Bypass Venturi Injector System 5**
(with Auxiliary Booster Pump)

- Irrigation controller
- Electrically interlocked control panel
- Electric motor and pump
- Single check valve with vacuum relief and low pressure drain
- Auxiliary booster pump
- Pressure gauge
- Gate valve
- Venturi
- To irrigation system

Chemical supply tank

- Solenoid valve (normally closed)
- Check valve
- Filter
Venturi Booster Pump Injection System

Bypass Venturi Injector System 6
(with Auxiliary Booster Pump)

- Chemical supply tank
- Filter
- Check valve
- Auxiliary booster pump
- Pressure gauge
- Gate valve
- Venturi
- Pressure gauge
- Gate valve
- Single check valve with vacuum relief and low pressure drain
- Gate or butterfly valve
- To irrigation system

Irrigation controller

Electric motor and pump

Electrical control panel

Hydraulically-operated valve (normally closed)
Venturi Booster Pump Injection System

Bypass Venturi Injector System 7
(with Auxiliary Booster Pump)
Venturi Booster Pump Injection System

Bypass Venturi Injector System 8
(with Auxiliary Booster Pump)
Chemigation Safety

Summary:

- Proper injection equipment is the first step in complying with injection safety requirements.

- It is effective in protecting the water supply, preventing chemical spills, and ensuring that injections occur when the irrigation system is operating properly.

- Check local regulations, especially for backflow prevention, to see if they exceed the label requirements.