Drip Irrigation Maintenance

A Guide for System Operators

"Prevention is better than Cure"

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CHAPTER 1 MAINTENANCE

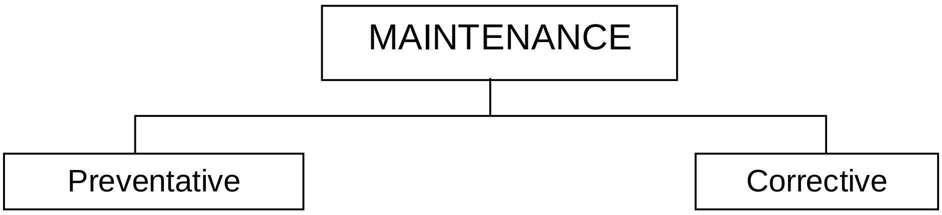
1.1 GENERAL

Drip maintenance is a very important, though often neglected tool to help keep your system running at peak performance and to increase the life expectancy of your drip system.

This can be achieved by implementing a simple but strict maintenance program. The following chapters will help you choose the correct procedure and guide you through implementation.

The best way to determine whether your maintenance program is working is to constantly monitor and record your system flow rates.

Drip Maintenance can be divided into two simple categories, preventative and corrective.



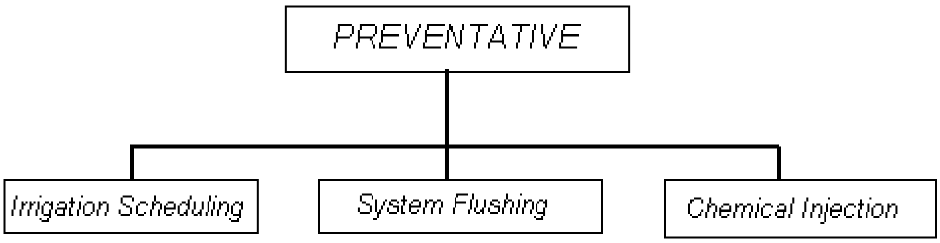
Preventative maintenance is a procedure or group of procedures to prevent or inhibit obstructions from plugging, clogging or blocking your drippers, providing that these procedures are conducted accurately. Animals and insects too can cause damage to the system components, the most worrying problem being damage to the drip laterals. (This problem of vermin control will be tackled in a separate "Installation Guidelines" booklet.)

Corrective maintenance is a procedure to remove the obstruction that has caused the dripper to be blocked. This is a very dangerous position to be in because not all obstructions can be removed.

CHAPTER 2 PREVENTATIVE MAINTENANCE

2.1 GENERAL

As far as dripper and emitter blockage is concerned, preventative maintenance can be further divided into three categories, irrigation scheduling, system flushing and chemical injection. We will also briefly mention Vermin control.



2.2 IRRIGATION SCHEDULING

Irrigation scheduling for preventative maintenance only pertains to surface or subsurface drip installation systems.

How we schedule our irrigation will prevent or minimize two common problems. These are commonly known as root intrusion and gravitation drainage.

Root Intrusion is created when the plant is water stressed and the roots search for moisture. Potentially, the roots can then grow into the dripper and block the dripper passages.
By monitoring the moisture level in the soil and scheduling our irrigation accordingly, we can minimize water stress and therefore we can minimize the condition for roots to grow into the dripper.

If there is a requirement for the crop to have a "drying off period", there are two alternative programs that can be implemented.

1. A series of short irrigation cycles will keep a higher moisture content around the dripper only.
2. Another practice is to inject a herbicide that kills the root tips without killing the plants themselves. This will be explained more in depth in the chemical injection chapter later.

CHAPTER 2 PREVENTATIVE MAINTENANCE

Gravitational Drainage is less common but may exist during prolonged periods of heavy rain. When the soil is over saturated and the drip line is empty (this condition is normally found on sloping sites), the water will flow backward into the dripper orifice bringing with it fine soil particles. The driplines under these circumstances acts as small drainage pipes. The small soil particles that have been drawn back into the dripper, if allowed to dry out, may block the drippers. Introducing a brief irrigation cycle shortly after the rain stops will aid in flushing out the small particles and help prevent blockages.

In very heavy and prolonged rain conditions, it is wise to flush your system before pulse irrigating.

A typical routine is to “pulse irrigate” every second day, until the soil is no longer over saturated. The term pulse irrigate is to conduct a short irrigation long enough for the system to reach the designed operating pressure plus 5 minutes of normal irrigation.

2.3 SYSTEM FLUSHING

System flushing is the procedure of opening flushing valves on your mainline, submain or laterals whilst under pressure. This procedure increases the velocity of water inside the pipe line or drip line to scour contaminants off the internal walls or individual dripper filters and removing these contaminants out of your system.

System Flushing should be conducted at regular intervals. The frequency will depend mainly on your water quality, loading and the weather. Table 2.1 indicates a starting point for your maintenance flushing program, from this, individual site conditions will influence whether to increase or decrease the flushing interval.

As previously mentioned, system flushing will only be effective if we can increase the velocity inside the dripline or drip tape to cause scouring of the internal walls. In certain cases, the pressure of the regulating control valve must be increased to permit such velocities in the submain and laterals. We have to be careful as not to exceed the burst pressure of the dripline or drip tape and take off adapters.

CHAPTER 2 PREVENTATIVE MAINTENANCE

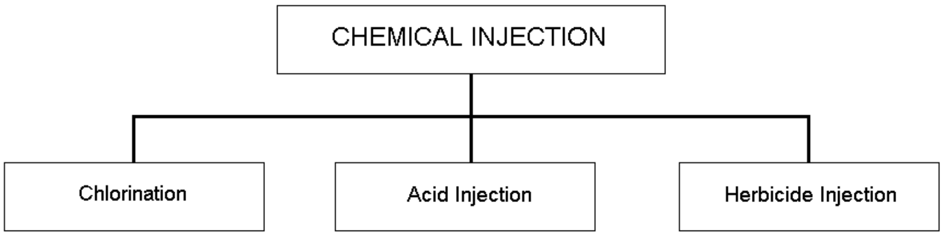
Recommended Flushing Interval Table 2.1

Quality	Water Source	Flushing Interval
Good	**Municipal** Supply	12 months
	Bore water with no presence of iron or magnesium	6 months
Average	**Rivers, Creeks or Canals** that are slow flowing	4 months
	Dams or Lagoons in a cold climate where the pumping point is properly placed, taking winds and the possibility of sedimentation into account	4 months
	Effluent water after effective sedimentation and complete biological treatment	4 months
Poor	**Bore water** which is drawn from a poor quality aquifer	Monthly
	Rivers, Creeks or Canals found in hot climates with increased biological growth and no chemical treatment	Monthly
	Dams or Lagoons in a hot climate. Poor placement of the pumping point in the direction of wind with little or no sedimentation or a soluble content that enables the development of a high organic load	Monthly
	Effluent water after effective sedimentation with little or no biological treatment	Monthly
Very Poor	**Bore water** which has a high load of iron or magnesium	Fortnightly
	Rivers, Creeks or Canals affected by flood flows and having a shortage of sedimentation facilities	Fortnightly
	Dams or Lagoons where the water source has been mixed with effluent or flood waters and the pumping point is poorly placed	Fortnightly
	Effluent water without sedimentation due to water flow and added oxygen	Fortnightly

CHAPTER 2 PREVENTATIVE MAINTENANCE

2.4 CHEMICAL INJECTION

Chemical Injection (Chemigation) is a procedure of injecting various chemicals into your irrigation system to prevent against potential plugging/clogging problems.
Chemical Injection can be broken down into three main categories, Chlorination, Acid Injection and Herbicide Injection.



Which treatment to use depends on the type of problem that exists, whether it is, Biological, Chemical or Physical.

Listed in table 2.2 are common names of potential plugging/clogging problems and which treatment is best suited to combat them.

Table 2.2

Type	Common Name	Treatment
Biological	Algae	Chlorination
	Red Iron Sludge	Chlorination
	Any Organic Material	Chlorination
	Slimy bacteria	Chlorination
	Iron or Manganese Bacteria	Chlorination
Chemical	Iron or Manganese Sulphides	Acid Injection
	Calcium and Magnesium Carbonate precipitation	Acid injection
	Any Inorganic Material	Acid injection
Physical	Root Intrusion	Herbicide Injection

CHAPTER 2 PREVENTATIVE MAINTENANCE

2.5 VERMIN CONTROL

Rats and crickets can be controlled to an extent by

1. Maintaining farm hygiene
   Rats require high protein diets, so ensure harbourage sites and reserves of seeds, grain etc. around farm buildings and field surrounds are kept secure from the rats and mice.
2. Planting trees along the river banks to shade out seed type grasses, stabilise soils and provide perches for owls and other natural predators.
3. Strategically and responsibly placing baits and poisons where this practice complies with local codes of conduct - be mindful of native and domestic animals and birds!
4. Trapping (preferable to baits and poisons)
5. Injection of chemicals through the drip tube. Exercise caution! Follow safe and established guidelines and procedures.

2.6 FREQUENTLY ASKED QUESTIONS

Question What is the easiest way to determine which chemical treatment for dripper cleaning works the best?

Answer *Take 2 water samples each from the end of your laterals, treat 1 sample with chlorine, the other sample with Acid. Allow to stand overnight and view which method best dissolves the contaminants.*

Question When installing a subsurface drip irrigation system how can I prevent insects chewing the tape?

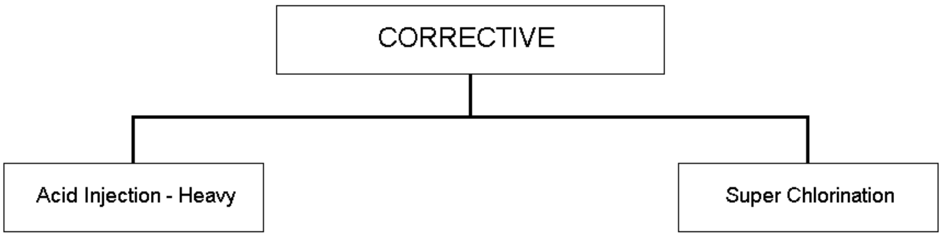
Answer *There are a few methods, but one of the quickest and easiest is to ensure you pump water into the system to flush debris out and to pressurise your tape as soon as possible after installation. This is not the only safeguard, but it is a necessary step.*

CHAPTER 3 CORRECTIVE MAINTENANCE

3.1 GENERAL

The first point that should be made clear when considering a corrective maintenance program is that the following treatments may not rectify your dripper/emitter blockage problem! *Remember that prevention is better than cure!*

There are two treatments that are considered as corrective maintenance, a heavy acid injection treatment and super chlorination.



3.2 ACID INJECTION - HEAVY

An Acid Injection to lower the water pH to a level of 2 is normally considered as a heavy treatment. Such a treatment would be considered for root intrusion or a high percentage of dripper/emitter blockages caused by mineral deposits. Several treatments may have to be conducted in order to reverse severe conditions.

Calculations and acid injection procedures can be found in Chapter 5 of this manual.

3.3 SUPER CHLORINATION

Super chlorination is the process of injecting chlorine in high concentrations, normally between 20 to 50 ppm. This process is considered as corrective maintenance and is normally conducted when there is a very high concentration of organic matter, thin red worms, eggs etc growing in the dripline.

N.B. Care must be taken to ensure that the active chlorine concentration will not harm your irrigation equipment/crop. If in doubt - ask.

Calculations and chlorination procedures can be found in Chapter 4 of this manual.

CHAPTER 4 CHLORINATION

4.1 SAFETY FIRST

- In its free state, chlorine is very toxic and corrosive.
- Always provide adequate ventilation when storing or handling chlorine.
- Always provide a source of readily available clean, fresh water.
- Remove any combustible material from areas where chlorine is stored or handled.
- Always wear proper protective clothing for eyes, hands and body parts.
- Chlorine in contact with your skin can cause serious burns.
- Never mix chlorine with fertilizer, this will create a reaction which can be explosive.
- Prior to filling any tank with chlorine solution, be sure it is absolutely clean of fertilizer or acid residue.

4.2 GENERAL

Chlorine is a chemical, which is available in three forms, solid, liquid or gas.

4.2.1 Types of Chlorine.

- Solid, as Calcium Hypochlorite, normally about 10% active
- Liquid, as Sodium Hypochlorite, normally about 12.5% active
- Gas, as pure gaseous chlorine, normally 100% active

Sodium Hypochlorite, or Liquid Chlorine, seems to be the most popular source of chlorine used in agricultural maintenance programs.

4.2.2 How to measure Chlorine.

Chlorine is easy to measure with a common swimming pool test kit. The swimming pool test kit measures what's called "FREE" or "RESIDUAL" chlorine.

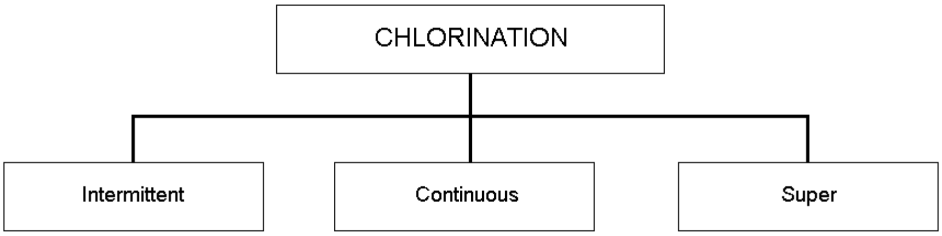
Chlorine concentrations deteriorate over time, even while stored in containers; therefore, infield storage should not exceed 20 days.

The process of injecting chlorine into you irrigation system is commonly known as chlorination.

The chlorination process involves injecting specific concentrations of free or active chlorine into your irrigation system to combat against most organic materials that build up in your drip system that may potentially block your drippers/emitters.

CHAPTER 4 CHLORINATION

There are three types of chlorination processes, two as a preventive maintenance regime, intermittent chlorination and continuous chlorination. The third is a corrective regime, commonly known as super chlorination.



4.3 INTERMITTENT CHLORINATION is the process of injecting chlorine into your irrigation system at routine intervals. Typical injection rates range from 5 to 10 ppm of free chlorine at the injection point, which is normally located at the system head (pump), but preferably after the primary filter. Table 4.1 below shows the suggested injection interval, which indicates a starting point. From this, individual site conditions will influence whether to increase or decrease the chlorination quantity and interval.

(This method is recommended even when using *secondary treated effluent water* through drip systems. Extensive trials at the Burgata "Platform" trials in Israel have indicated that chlorination every 3 to 7 days is sufficient to keep the drippers functioning well.)

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Chlorination Interval Guidelines Table 4.1

Quality	Water Source	Chlorination Interval
Average	**Rivers, Creeks or Canals** which are slow flowing	9 months
	Dams or Lagoons in a cold climate where the pumping point is properly placed, taking winds and the possibility of sedimentation into account	6 months
	Effluent water after effective sedimentation and complete biological treatment	Weekly
Poor	**Rivers, Creeks or Canals** found in hot climates with increased biological growth and no chemical treatment	3 months
	Dams or Lagoons in a hot climate. Poor placement of the pumping point in the direction of wind with little or no sedimentation or a soluble content that enables the development of a high organic load	3 months
	Effluent water after effective sedimentation with little or no biological treatment	2 to 3 days
Very Poor	**Rivers, Creeks or Canals** affected by flood flows and having a shortage of sedimentation facilities	Monthly
	Dams or Lagoons where the water source has been mixed with effluent or flood waters and the pumping point is poorly placed	Fortnightly
	Effluent water without sedimentation due to water flow and added oxygen	Daily

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4.4 CONTINUOUS CHLORINATION

Continuous chlorination is the process of continually injecting chlorine while the irrigation system is in use.
Continuous chlorination is normally used:

- When we have a high continuous loading of organic material normally found with poor or very poor effluent water. It is usually recommended to inject chlorine after the filters - the reason being is to allow the filters to capture and get rid of as much of the organic load as possible. This will ensure that less chlorine will be used over time. However the injection point can be located just before the primary filtration system so as to treat the filters as well. Chlorine reacts with certain metals including stainless steel, so the filters can be damaged if chlorine is allowed to rest in the filters for any length of time. Typical injection rates range from 1 to 3 ppm of chlorine at the injection point.
- When we have iron in our water supply, the chlorine will act as an oxidizer and precipitate the iron out of the water; the precipitated iron is then generally caught in media filters before entering into your irrigation system. The injection point is normally located directly after the pump, which allows the longest contact time for the chlorine to do its work. In some cases, extra mainline is installed to increase the contact time. Typical injection rates will depend on the iron concentration in your water, normally, for every 1ppm of iron we would inject 1.5 ppm of free chlorine.

N.B. Care must me taken to ensure that the active chlorine concentration will not harm your irrigation equipment/crop.

When the chlorine is injected into the water, the free chlorine is composed of two compounds, hypochlorous acid (HOCl) and hypochlorite (OCl^-). The relative percentage of hypochlorous acid versus hypochlorite varies with the water pH. A low pH pushes the reaction from the hypochlorite side to the hypochlorous acid side. Hypochlorous acid is 40 to 80 times more powerful as a biocide than hypochlorite. For effective chlorine treatment, alkaline water should be acidified to a pH of 6.5 so that the hypochlorous acid dominates.

The procedure of acidifying the water prior to chlorination requires two injection pumps; therefore this process is normally adapted for continuous chlorination only.

Notes:

- The water acidification and chlorine injection process should be done at two different injection ports; the acid should be injected prior to the chlorine.
- Mixing acid and chlorine liquid in the same tank will produce highly toxic chlorine gas.

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- Chlorine injection combined with herbicides or pesticides may reduce the effectiveness of herbicides or pesticides because the chlorine attacks the organic composition of these chemicals.
- Usually chlorine gas is used for continuous chlorination - capital equipment costs are higher, but the ongoing costs are lower.

4.5 SUPER CHLORINATION

Super chlorination is the process of injecting chlorine in high concentrations, normally between 20 to 50 ppm. This process is considered as corrective maintenance and is normally conducted when there is a very high concentration of organic matter; thin red worms or eggs are growing in the dripline.
N.B. Care must me taken to ensure that the active chlorine concentration will not harm your irrigation equipment/crop.

4.6 CALCULATING INJECTION RATES AND TIMES

The calculations used will determine two factors,

- The Injection quantity.
- The Injection time.

4.6.1 Injection Quantity

Before we can proceed with any calculations, we need to determine three main factors.

- System flow rate.
- Active chlorine concentration of your solution expressed as a percentage.
- Desired concentration of free chlorine for your treatment.

Listed below are two main formulas, which are used to calculate our injection rate.

1. This formula calculates all variable parameters in one formula.

$$q = \frac{C1 \times Q}{Co \times 10}$$

= litres/hour

q = Injection rate (l/hr)
C1 = Desired concentration (ppm)
Q = System Flow Rate (m^3/hr)
Co = Active chlorine %

E.g.

$$q = \frac{10 \times 140}{12.5 \times 10}$$

$$= \frac{1400}{125}$$

= 11.2 litres/hour (of liquid Sodium Hypochlorite)

140m^3/hr System flow
Using liquid Sodium Hypochlorite 12.5%

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2. Now this formula calculates a <u>concentration constant</u> of 1ppm for 1m³/hr. Then it is just a matter of multiplying this constant value by your system flow rate and desired concentration of free chlorine required per treatment.

	✕ = 1 ÷ concentration % ÷ 10	✕ = constant
E.g.	Liquid chlorine	
	✕ = 1 ÷ 12.5 % ÷ 10	Sodium Hypochlorite = 12.5%
	= 0.008	

E.g.	q= ✕ x Q x C	q	= Injection rate (l/hr)
		✕	= Constant
	= 0.008 x 140 x 10	Q	= System Flow Rate (m³/hr)
		C	= Chlorine required (ppm)
	= 11.2 litres/hour		

Table 4.2 below shows the concentration constant for different chlorine solutions available in Australia.

Table 4.2

Chlorine Form	Chlorine Type	Concentration	Constant
Solid	Calcium Hypochlorite	10%	0.01
Liquid	Sodium Hypochlorite	12.5%	0.008
Gas	pure gaseous chlorine	100%	0.001

CHAPTER 4 CHLORINATION

4.6.2 Injection Time

The calculated injection time is a rough measurement, which determines when we should start testing the end of the laterals for Free or Residual Chlorine.

The injection time can be calculated in two different ways.

1. Inject a dye (red or blue food colouring), and measure the time taken for the dye to reach the end of the furthest lateral.
2. Calculate using water velocities in the pipe work to be treated.

Typical system velocities to base your calculations on are as follows:

- Mainline 1.0 m/sec
- Submain 1.0 m/sec
- Laterals 0.3 m/sec.

For example, Table 4.3 below calculates the minimum injection time for a given valve or shift.

Table 4.3

Pipe Work	Length (m)	Velocity m/sec	Time Sec.
Mainline	550	1.0	550
Submain	140	1.0	140
Lateral	270	0.3	900
		InjectionTime (secs)	1590

There are blank forms in Appendix A, which may be helpful.

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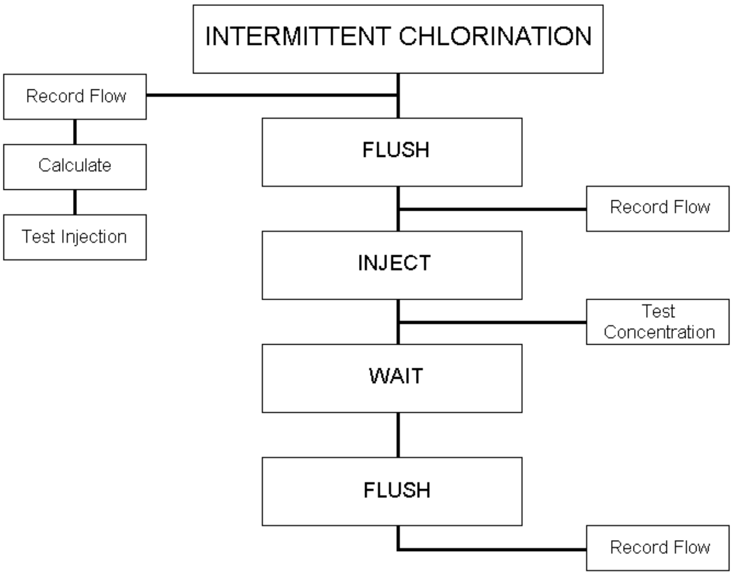
4.7 CHLORINATION PROCEDURES

The diagram below FIG 4.1 displays the events in which the intermittent chlorination procedure should follow.

FIG 4.1



4.7.1 Record Flow

The Intermittent chlorination procedure should start by recording the system flow; this is done for three reasons.

1. The current flow rate recorded can be cross-referenced to the original system flow rate to determine if any system deterioration has occurred.
2. To determine if the system flushing and chlorination process has improved your systems flow rates.
3. To base your calculations to determine your injection quantities.

4.7.2 Calculate

Calculate your injection rate and injection time.

4.7.3 Test Injection

It is recommended that you should test and calibrate your injection equipment with water first and adjust if necessary to obtain the correct injection rate before injecting expensive chemicals.

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4.7.4 Flush

The system should be flushed from tip to toe so to speak. This includes flushing of mainlines, secondary filters, submains and laterals. The main reason is to reduce the organic loading in the system so as to minimise the amount of chlorine used. This will save time and money!
It is important to achieve adequate velocities in the pipe work to induce scouring. Typical flushing velocities per section are listed below.

- Mainline 1.5 m/sec
- Submain 1.5 m/sec
- Typhoon/Dripline 2000/Dripmaster 17 Lateral 0.5 m/sec
- Python/Dripline 2025 Lateral 0.4 m/sec
- Ozline Lateral 0.39 m/sec

When flushing, we need to calculate how long to flush each item. This is easily calculated by dividing the length of the pipe work by the flushing velocity.
In general, you should see two waves of contaminants being flushed. The first wave is from the contaminants sitting in the end of the lines; the second wave is a result of the scouring effect. The second wave is not as dark as the first but lasts considerably longer.

4.7.5 Record

The system flow rate is only recorded if you wish to know that the flushing process actually lifted systems performance.

4.7.6 Inject

Now you are ready to proceed with the actual injection process. The process should only commence once the system has reached normal operating pressure.

4.7.7 Test

When you are approaching the end of your injection time, take a small sample of water from the end of a lateral and test for free chlorine.
Once you detect free chlorine (0.5 – 1.0 ppm), we generally wait approximately one to two minutes extra, as to allow the chlorine to work through the drippers passages, then repeat this process for the next shift or shut that system down.

4.7.8 Wait

We allow the chlorinated water to sit in the system from 2 to a maximum of 12 hours before we proceed with the next step.

4.7.9 Flush

The entire system should be flushed, following the same procedure as mentioned earlier.

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4.7.10 Record

The system flow rate should be recorded to acknowledge whether the chlorination process lifted system performance.

4.8 FREQUENTLY ASKED QUESTIONS

Question I have been told that I should lower pH of the water to 6.5 for the chlorine to work better.

Answer *This is true, but if you look at it logically, you need two injection pumps to conduct this operation. If you chlorinate on a regular basis or continuously, then it would be economical to do so. If you don't chlorinate regularly, then the only draw back is that you will use more chlorine.*

Question How can I measure free chlorine at the end of the dripline if I don't have any testing equipment ?

Answer *Depending on how good your nose is, you should be able to smell the chlorine in the water if it is higher than 2 ppm.*

Question How long will chlorine last for while it is in containers ?

Answer *This depends on the storage environment, typically speaking, the chlorine will degrade over time. You should buy just enough chlorine for your chlorination program or a maximum of 20 days supply, which ever comes first.*

CHAPTER 5 ACID INJECTION

5.1 SAFETY FIRST

- If acid comes in contact with the skin, it can cause serious burns.
- Always provide adequate ventilation when storing or handling Acids.
- Always have a readily available source of clean, fresh water on hand.
- Always wear proper protective clothing for eyes, hands and body parts.
- Acids are very corrosive to a whole range of materials.
- Do not inject Phosphoric acid if you have more than 50 ppm of calcium in the water.
- Always add acid to water; never add water to acid.

OTHER POINTS FOR CONSIDERATION

1. Acid is corrosive! Polyethylene and PVC tubing is resistant to acid though. Use an injection pump that is acid resistant. Use PVC and plastic valves wherever possible. Aluminium, steel (with or without inner concrete coating) and asbestos-cement pipes are damaged by corrosion. Always flush with fresh water for about one hour after treatment.
2. Do not use Phosphoric acid in water that has iron in it!
3. It is always better to inject with acid at the entrance to the block if at all possible. The block control head should have injection points. This method will use the least amount of acid

5.2 GENERAL

Acid injection is the process of injecting specific concentrations of acid into the irrigation system during regular system operation to lower the pH level in the water which will dissolve calcium and magnesium carbonates, iron or manganese sulphides and to burn plant roots that have entered the dripper.

5.2.1 Types of Acids

Acids come in various forms and in different concentration levels.

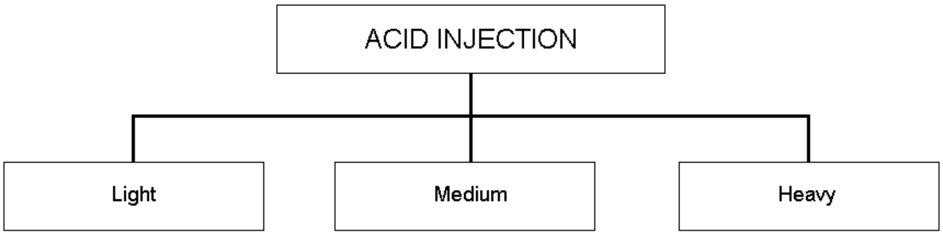
- Nitric Acid 60%
- Phosphoric Acid 75% - 85%
- Sulphuric Acid 90% - 96%
- Hydrochloric Acid 30% - 35%

The most common acids are Sulphuric Acid (Battery Acid) and Hydrochloric Acid (Swimming pool Acid).

CHAPTER 5 ACID INJECTION

There are three types of Acid injection processes, light, medium and heavy. Each treatment is designed to lower the pH of the water sufficient enough to treat the targeted problem, while minimizing the amount of acid to be used.

i.e. There is no requirement to lower the pH to a level of 2 for the treatment of dissolving calcium carbonates.



LIGHT treatments are considered for dissolving minerals. Typically, the pH level should be between 4-5.

MEDIUM treatments are to be considered for dissolving iron Typically, the pH level should be between 2-3.

HEAVY treatments are to be considered for burning roots that have intruded into the dripper passages. Typically, the pH level should be between 2-2.5.
Several heavy treatments may be required, depending on the severity of root intrusion.

5.3 CALCULATING INJECTION RATES AND TIMES

The calculations we are using will determine two factors.

- The Injection quantity
- The Injection time

5.3.1 Injection Quantity

Before we can proceed with any calculations, we need to determine two main factors.

- Valve flow rates
- pH level for treatment

The valve flow rates are normally indicated on your irrigation design plan. They can also be measured through a water meter if you have one installed.

CHAPTER 5 ACID INJECTION

We need to find out what level of treatment will best suit your system. As mentioned earlier, there are 3 levels of treatment, light, medium and heavy.

There are two methods for calculating the amount of acid to inject into your system. The first is a “Rule of Thumb” method - **this is considered a heavy dosage and is generally not recommended**. The other is more accurate, but several tests need to be conducted to ascertain the correct amount of acid to inject. This is known as a "titration test".

5.3.2 Rule of Thumb Method

Suitable acids concentrations (as mentioned earlier) are injected at 0.6% of valve flows.

FLOW in m^3/hr x 0.6% = injected flow rate in m^3/hr

For example:
Flow = 27 m^3/hr
27 x .006 = 0.162 m^3/hr or 162 litres/hour

Question: How much acid is required?

Answer: If our injection time is for only 15 minutes, then the total liters of acid to be injected will be a fourth of the injection rate calculated.

For example: 162 ÷ 4 = 40.5 litres.

As you will realize from the above formula, the water quality is not taken into account and this formula is considered for **very heavy treatments** only.

5.3.3 Titration Method (Recommended)

This method allows us to calculate the exact quantity of any acid in various types of water qualities at a given time. We can develop a titration curve in the field by following a few simple procedures.

The Titration Test.

Equipment required:
- 10 litre bucket
- 1 ml dispenser, acid resistant
- 0-14 pH test strips or pH meter
- 10 litre water sample
- Acid
- Blank Titration chart Table 5.1

CHAPTER 5 ACID INJECTION

Procedure:

1. Place 10 litres of your water sample in bucket.
2. Record pH level of water sample
3. Add 1 ml of acid and mix solution
4. Record pH level of water sample
5. Repeat steps 3 and 4 until a pH level of 2 is obtained.

After you have recorded your titration curve, follow a few calculations to determine how much acid to inject over a given time.

Formula:

Acid ml **A** ÷600 (Constant) = [ ] **X** Flow **B** m³/hr = Injection rate [ ] Liters/min.

Injection rate (Liters/min.) **X** Injection Time **C** minutes = Injection Qty. **Y** litres

Injection rate (Liters/min.) **X** 60 minutes = Injection rate **Z** litres/hour

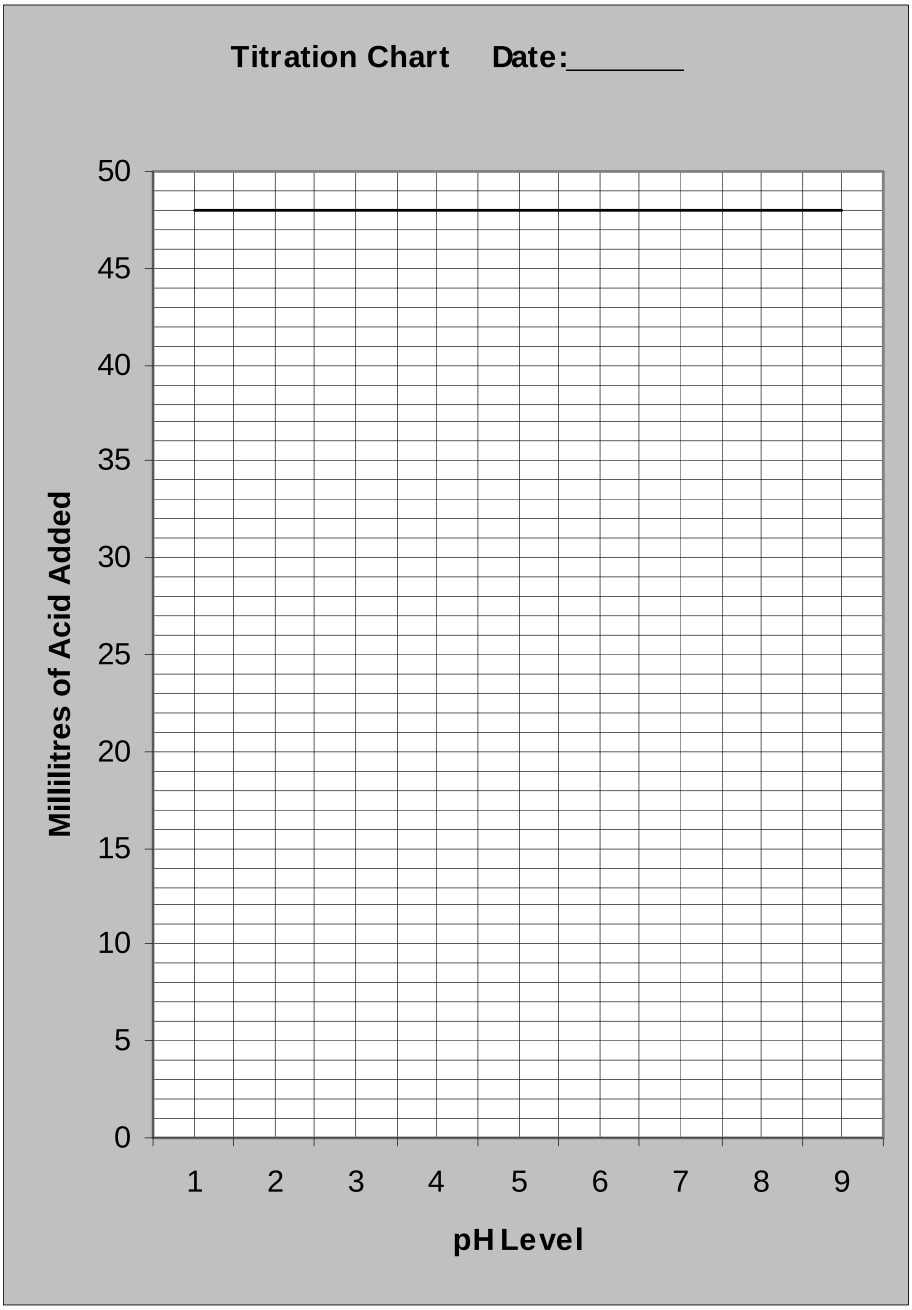
Where:
A = Titration Acid level in ml at desired pH level.
B = Valve flow rate
C = Injection time for Acid to reach last dripper

This formula will show us two values:
Y = The amount of acid to be injected
Z = The injection rate of acid

CHAPTER 5 ACID INJECTION

Example of a Titration Chart

Table 5.1

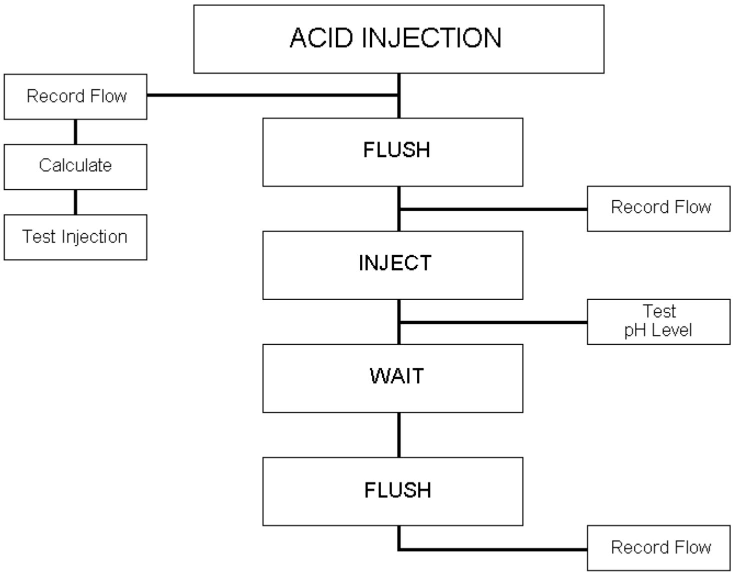


CHAPTER 5 ACID INJECTION

5.4 ACID INJECTION PROCEDURES

The diagram below FIG 5.1 displays the events in which an Acid Injection procedure should follow.

FIG 5.1



5.4.1 Record Flow

The Acid Injection procedure should start by recording the valve flow rate; this is done for three reasons.

1. The current flow rate recorded can be cross-referenced to the original valve flow rate to determine if any system deterioration has occurred.
2. To determine if the system flushing and acid injection process has improved your valve flow rates.
3. To base your calculations to determine your injection quantities.

5.4.2 Calculate

Calculate your injection rate and injection time.

5.4.3 Test Injection

Its recommended that you should test and calibrate your injection equipment with water first and adjust if necessary to obtain the correct injection rate before injecting expensive acids.

CHAPTER 5 ACID INJECTION

5.4.4 Flush

The section to be treated must first be flushed. This includes flushing of the secondary filters, submains and laterals. The main reason is to reduce the mineral loading in the system so the acid does not have to work so hard.
If system flushing is ignored, there is a high chance that after the injection process, that you may move the contaminants located on the internal walls of the sub-main and laterals and send this high loading directly into the drippers themselves.

It is important to achieve adequate velocities in the pipe work to induce scouring. Typical flushing velocities per section are listed below.

- Mainline 1.5 m/sec
- Submain 1.5 m/sec
- Typhoon/Dripline 2000/Dripmaster 17 Lateral 0.5 m/sec
- Python/Dripline 2025 Lateral 0.4 m/sec
- Ozline Lateral 0.39 m/sec

When flushing, we need to calculate how long to flush each item. This is easily calculated by dividing the length of the pipe work by the flushing velocity.
In general, you should see two waves of contaminants being flushed. The first wave is from the contaminants sitting in the end of the lines; the second wave is a result of the scouring effect. The second wave is not as dark as the first but lasts considerably longer.

5.4.5 Record

The system flow rate is only recorded if you wish to know that the flushing process actually lifted systems performance.

5.4.6 Inject

Now you are ready to proceed with the actual injection process. The process should only commence once the system has reached normal operating pressure.

5.4.7 Test

When you are approaching the end of your injection time, take a small sample of water from the end of a lateral and test the pH level.
Once you detect your target pH level, generally wait approximately one to two minutes extra, as this will allow the acid to work through the drippers passages, then this process is generally repeated for the next valve.

5.4.8 Wait

We allow the treated water to sit in the system from 2 to 6 hours before we proceed with the next step. This period may be longer if you are trying to correct a root intrusion problem - and are using a stronger concentration.

CHAPTER 5 ACID INJECTION

5.4.9 Flush

The entire system should be flushed, following the same procedure as mentioned earlier.

5.4.10 Record

The system flow rate should be recorded to acknowledge whether the Acid Injection process lifted system performance.

Please note that when treating a root intrusion problem, it may be necessary to repeat this process 2 to 3 times on a two-day interval.

5.5 FREQUENTLY ASKED QUESTIONS

Question What type of acid should I use and where can I buy it?

Answer *Hydrochloric Acid is the most commonly used, and is generally considered to be one of the "safer" acids available. It is used a lot in domestic swimming pools for pH control so is available from swimming pool shops, Hardware stores and hopefully your local irrigation dealer.*

Question Do I inject the acid "undiluted"?

Answer *No, usually you should do an initial dilution of about one tenth (1/10) of your injector pump's maximum capacity*

CHAPTER 6 HERBICIDE INJECTION

6.1 GENERAL

Herbicide injection or Herbigation/Chemigation as it is more commonly known, is the process of injecting herbicides into the irrigation system.
For root intrusion prevention, choose a Herbicide that has been recommended for your crop type and injection method. The concentration level of the herbicide should be calculated to kill root tips without killing the plants themselves, thus preventing roots from growing into the drippers.

A Herbicide injection treatment is normally conducted on permanent drip systems:

- that are buried (subsurface drip).
- which are installed on the surface and covered with a layer of organic mulch.

For annual crops such as lettuce, tomatoes, capsicum or melons, avoiding water stress during the growing season commonly minimizes root intrusion.

For more permanent crops like sugarcane, the Herbicide injection program is best suited.

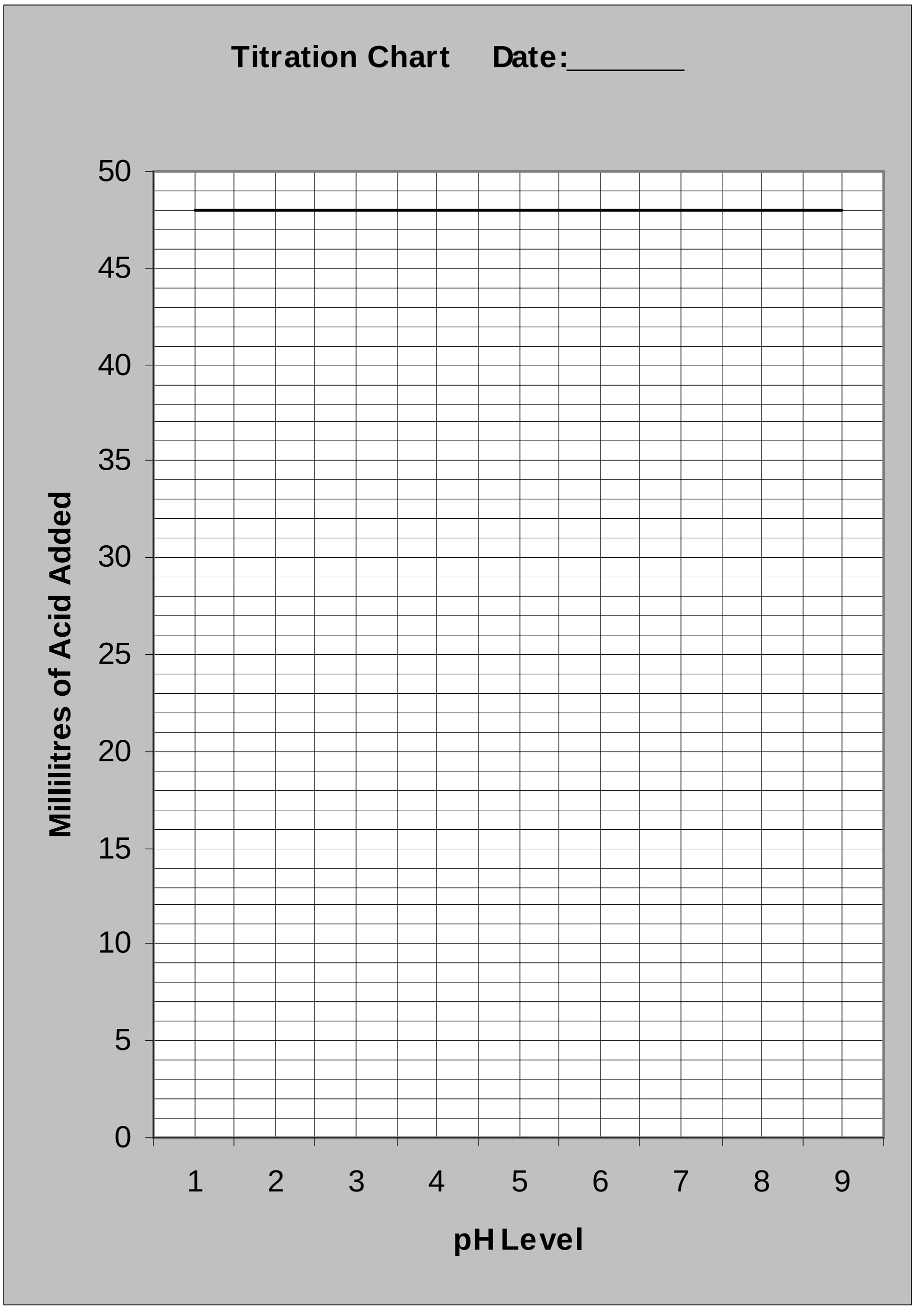
6.1.1 Herbicide Injection Process

The injection process works best if the soil is drier rather than wetter.

1. Calculate the amount of herbicide required for the area to be treated.
2. Calibrate injection equipment.
3. Inject chemical immediately after the system has pressurized. This allows the herbicide to come into contact with soil particles closest to the dripper.
4. Shut the system down for a minimum of 24 –48 hours

APPENDIX A

Titration Chart



APPENDIX B

Working Chlorination Form

Working Chlorination Form							
Valve/Shift	Flow Rate		Injection		Chlorination ppm		Water
Number	Before	After	Rate l/hr	Time	Start	Finish	pH

APPENDIX C

Working Acid Injection Form

Working Acid Injection form						
Valve/Shift Number	Flow Rate		Injection		Water pH	
	Before	After	Rate l/hr	Time	Start	Finish

APPENDIX D

Injection Time Calculation Form

Valve/Shift No.

Pipe Work	Length	Velocity m/sec	Time Sec.
Mainline		1.0	
Submain		1.0	
Lateral		0.3	
		Injection Time	

Valve/Shift No.

Pipe Work	Length (m)	Velocity m/sec	Time Sec.
Mainline		1.0	
Submain		1.0	
Lateral		0.3	
		Injection Time	

Valve/Shift No.

Pipe Work	Length (m)	Velocity m/sec	Time Sec.
Mainline		1.0	
Submain		1.0	
Lateral		0.3	
		Injection Time	

Valve/Shift No.

Pipe Work	Length (m)	Velocity m/sec	Time Sec.
Mainline		1.0	
Submain		1.0	
Lateral		0.3	
		Injection Time	

Valve/Shift No.

Pipe Work	Length (m)	Velocity m/sec	Time Sec.
Mainline		1.0	
Submain		1.0	
Lateral		0.3	
		Injection Time	

Note:
Divide Length (m) by Velocity (m/s) to calculate Time in seconds