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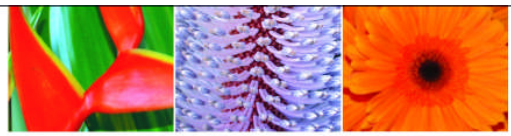

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# Drip Irrigation Maintenance

Drip irrigation is known for its efficient use of water, and high uniformity. Routine maintenance is essential to prevent problems and to maintain system uniformity in order to get the longest possible life out of drip irrigation systems.

## Water quality

The first step in maintaining a system is to know your water quality by sampling of the water sources you intend to use. This information aids the designer in determining the flushing and filtration requirement for the system. This in turn affects the choice of emitter and drip tape size, as well as run irrigation length. **There are three types of clogging hazards that need to be considered in the design and maintenance program. These are physical, chemical and biological**.

**1. Physical clogging hazards** (include sand and silt). Filtration is generally designed to remove particles above the maximum allowable particle size for the emitters being used. As a rule of thumb, this is usually particles greater than one-tenth the size of the smallest diameter in the emitter pathway. The reason for this is that bridging of particles greater than this size can lead to emitter clogging, particularly if bonding glues formed by biological activity develop in the tape or emitter.

**2. Chemical clogging hazards:**

✦ Bicarbonate concentrations exceeding about 2 meq/L and pH exceeding about 7.5 can cause calcium carbonate precipitation.

✦ Calcium concentrations exceeding 2 to 3 meq/L can cause precipitates to form during injection of some phosphate fertilisers. Special procedures are necessary for the injection of phosphate fertilisers.

✦ High concentrations of sulphide ions can cause iron and manganese sulphide precipitation. These precipitates are very insoluble, even to acid solutions. Frequent acidification or the use of a settling basin for separating these precipitants is needed.

✦ Irrigation water containing more than 0.1 mg/L sulphides may encourage the growth of sulphur bacteria within the irrigation system. Regular chlorination may be needed.

Chlorination when manganese is present should be used with caution, as a reaction time delay may occur between chlorination and development of the precipitate. This may cause the manganese precipitate to form downstream of the filter leading to emitter clogging.

**3. Biological clogging hazards** result from the growth of bacterial slimes and algae within drip tapes and emitters. They combine with clay particles to block the emitters. Bacterial precipitation of sulphur and iron is a further problem.

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**Table 1.** Potential clogging problems associated with drip irrigation

| Problem | Abbrev. | Units | Level of concern | | |
|---|---|---|---|---|---|
| | | | Low | Moderate | High |
| pH | | | < 7.0 | 7 - 8 | > 8.0 |
| Bicarbonate | $HCO_3$ | meq/L | <2.0 | >2.0 | >2.0 |
| Iron | Fe | mg/L | < 0.2 | 0.2 - 1.5 | > 1.5 |
| Manganese | Mn | mg/L | < 0.1 | 0.1 - 1.5 | > 1.5 |
| Hydrogen sulphide | $H_2S$ | mg/L | <0.2 | 0.2 - 2.0 | >2.0 |
| Total dissolved solids | TDS | mg/L | <500 | 500 - 2000 | >2000 |
| Suspended Solids | | mg/L | <50 | 50 - 100 | >100 |
| Bacteria Count | | no./mL | <10,000 | 10,000 - 50,000 | >50,000 |

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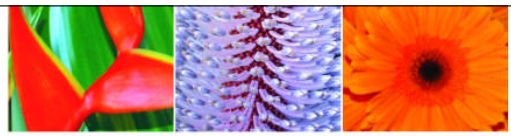

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## Treatment Option

| Problem | Treatment Options |
|---|---|
| Carbonate precipitation (white precipitate) | 1. Continuous injection: maintain pH between 5 to 7.<br>2. Periodic injection: maintain pH at under 4 for 30 to 60 minutes daily. |
| Iron precipitation (red precipitate) | 1. Aeration and settling to oxidise iron (best treatment for high concentrations - 10 mg/L or more<br>2. Chlorine precipitation - inject chlorine to precipitate iron<br>✦ use an injection rate of 1 mg/L of chlorine per 0.7 mg/L of iron<br>✦ inject in front of filter so that the precipitate is filtered out<br>✦ Reduce pH to 4 or less for 30 to 60 minutes daily. |
| Manganese precipitate (black precipitate) | Inject 1 mg/L of chlorine per 1.3 mg/L of manganese in front of the filter. |
| Iron bacteria (reddish slime) | Inject chlorine at a rate of 1 mg/L free chlorine continuously or 10 to 20 mg/L for 30 to 60 minutes daily. pH must be under 7 for chlorination to be effective. |
| Sulphur bacteria (white cottony slime) | 1. Inject chlorine continuously at a rate of 1 mg/L per 4 to 8 mg/L of hydrogen sulphide (pH must be under 6 for chlorination to be effective), or<br>2. Inject chlorine intermittently at 1 mg/L free chlorine for 30 to 60 minutes daily (pH must be under 6 for chlorination to be effective). |
| Bacterial slime and algae | Inject chlorine at a rate of 0.5 to 1 mg/L continuously or 20 mg/L for 20 minutes at the end of each irrigation cycle. |
| Iron sulphide (black sand-like material) | Dissolve iron by injecting acid continuously to lower pH to between 5 and 7. |

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## Maintenance schedule

Maintenance is largely preventative. Silt and organic matter should be excluded from the system as much as possible using settling ponds and filtration.

Regularly walk the field to check on the system and address problems quickly. Take samples from the ends of laterals and let it stand overnight to check for sediment. Test the water periodically. Check laterals for any deposits.

Flush the system regularly as determined by your water quality. Monitoring and recording system flow rates on a water meter can indicate if clogging is occurring and flushing required. Start the flushing process from the pump onwards. Make sure the filters are clean and pressures set correctly. Systematically clean the mainline, sub-mains, laterals and flushing manifold. Inlet water pressure may need to be increased to achieve the necessary flushing velocity in the laterals - check if this is needed on your design specifications.

Don't inject substances into the system unless they are completely water-soluble. The injection point must be before a filter. Mix the material to be injected with your irrigation water in a container and leave overnight - if sediments or deposits form do not use it.

Pressures at the furthest end of the system should be regularly checked and recorded to ensure that the system is operating to design specification. Make sure accurate pressure gauges are used for this testing - gauges normally installed on irrigation systems have a short life and are generally inaccurate. Purchase a high quality gauge and use it to perform pressure checks.

Adhere to the maintenance schedule recommended by your system supplier to get the best from your system.

**Table 2.** Recommended Drip Maintenance Schedule

| |
|---|
| **Prior to installation of system** |
| Water quality analysis |
| **Prior to starting the first irrigation season (and at any time system pressure or flow rate is reset)** |
| 1. Filter system adjustment<br>✦ media cleaning<br>✦ backflush flow adjustment<br>✦ backflush frequency adjustment<br>✦ backflush duration adjustment<br>✦ backflush dwelling-time adjustment (the time between flushing of each two consecutive tanks). |
| 2. System evaluation - test flow rate, operating pressure and distribution (emission) uniformity |

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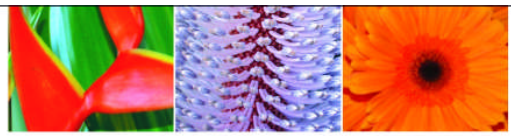

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|---|
| **Annually before the beginning of Irrigation Season** |
| 1. Undertake system evaluation - test flow rate, operating pressure and distribution (emission) uniformity |
| 2. Inspect pumping station and pump/motor maintenance |
| 3. Test bore and pump |
| 4. Inspect all system components and replace defective ones |
| 5. Inspect media and screen filters |
| 6. Flush system |
| **During the irrigation season** |
| 1. Daily observations<br>✦ walk the field and repair any system irregularities<br>✦ check screen/media filter performance<br>✦ check and record system pressure and flow rate. |
| 2. Weekly observations<br>✦ check for emitters clogging<br>✦ clean screens and strainers<br>✦ flush laterals. |
| 3. Monthly observations<br>✦ perform screen/media filter maintenance<br>✦ measure and record laterals pressure - compare to system design<br>✦ measure emitter discharge rate at selected locations<br>✦ check pH of water from lateral flushing - maintain below pH6.5. |
| **As needed** |
| 1. Acid injection |
| 2. Chlorine injection |
| **Annually before system shutdown** |
| 1. System flushing |
| 2. Chlorination |

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## Chlorination

Chlorination must be used routinely to kill algae and loosen bonded organic matter within the system for flushing out. It has no effect on scale (lime or calcium carbonate) deposits in the system. Liquid sodium hydrochloride is the recommended chlorine source. It is injected into the system during regular operation usually using the fertigation equipment (provided it is chlorine tolerant). Application is either continuous (a low dose rate) or intermittent (a high dose rate).
The injection point should be as close to the treated system as possible as the residual chlorine concentration decreases with time and distance from the injection point. There is no particular volume of chlorine that should be used as every system and its contamination issue is different. Table 3 summarises the recommended chlorine concentrations to achieve particular objectives:

**Table 3.** Recommended chlorine doses

| Chlorination Objective | Chlorination Method | Required Concentration (mg/L) | |
|---|---|---|---|
| | | System Start | System End |
| Sediment Prevention | Continuous | 3 - 5 | > 1 |
| | Intermittent | 10 | > 3 |
| System Cleaning | Continuous | 5 - 10 | > 3 |
| | Intermittent | 15 - 20 | > 5 |

The required discharge of injected chlorine solution is calculated using the formula:

$$q = \frac{C_1 \times Q}{C_0 \times 10}$$

where

$q$ = discharge of injected chlorine solution (L/hour)
$C_0$ = percentage of active chlorine in injected solution (%)
$C_1$ = Desirable concentration of active chlorine in irrigation water (mg/L)
$Q$ = discharge of the treated system ($m^3$/hour)

**Example:**

System flow rate: $Q$ = 125 $m^3$/hour
Active chlorine % in the solution $C_0$ = 10%
Desired concentration $C_1$ = 15 mg/L

$$q = \frac{C_1 \times Q}{C_0 \times 10}$$

$$= \frac{15 \times 125}{10 \times 10}$$

$$= 18.75 \text{ L/hour}$$

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Use a chlorine test kit to measure the active chlorine in the irrigation water at the start and end of the system during chlorination to ensure that the required concentrations are reached. *NB: High levels of organic matter in the water will react with the chlorine, reducing its ability ti disinfect, water needs ti be filtered or chlorine dose increased to account for level of organic matter.*

Chlorine is more effective in acid waters. High pH or alkaline waters should be acidified to a pH of 6.5 for effective chlorine treatment.
**WARNING: Active chlorine is very dangerous. Follow all safety instructions for its use and never place it in a tank containing any residual fertiliser. Direct contact of chlorine and fertiliser can result in an explosive reaction.**

## Acid injection

Acid injection should only be used to treat chemical deposits (carbonates, hydroxides and phosphates) in the drip system - it is not effective for organic sediments. The aim is to drop the water pH to a level where these deposits become soluble and can be flushed from the system.

There are several technical acids available that can be used for acid injection - hydrochloric, sulphuric, nitric and phosphoric. They are marketed in a range of concentrations and most appropriate rate should be determined using a bucket titration. Add 10 L of water to a bucket and using a glass eyedropper add acid 1 mL at a time and test pH until the desired level is reached. For periodic treatment this could be as low as pH 4.0. Using these measurements and system flow rates, an injection rate in L per hour of acid can be calculated.

Prior to treatment thoroughly flush the system. Inject the acid solution for a period of 10 to 12 minutes - checking the pH at the flushing end of the system to make sure the desired pH is achieved. Following treatment continue irrigating with clean water for at least one hour and flush the system thoroughly.

Acids are very corrosive to steel, cement and aluminium - polyethylene and PVC are resistant. Make sure the injection pump is tolerant of acids and has been calibrated.
**WARNING: Acids are very dangerous - always follow all instructions for use and safety precautions. Always add acid to water, NEVER add water to acid as a dangerous reaction can result.**

Treatment should always be done well before total clogging has occurred. Success in this situation will be limited as it is difficult for the acid to reach the precipitants in closed emitter passages.

Acid can be used to burn root hairs in emitters. However, high rates are required and it is very expensive. It is best to prevent root intrusion in the first place through appropriate design, installation and irrigation management.

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