Water for Profit

CHLORINATION OF MICRO-IRRIGATION SYSTEMS

WATERFORPROFIT

Satisfactory filtration and pre-treatment of micro-systems are two major functions to ensure peak system performance and longevity.

Introduction

Deposits can be prevented by applying chlorine and acid during irrigation, and/or opening the line ends to allow water to flush straight through. This information sheet examines chlorination maintenance.

Chlorination

Chlorinate the water supply if it contains organic matter such as algae or more than 0.1 mg/L of iron. Some chemical costs may be avoided if water with more than 1 mg/L of iron is pre-treated. Continuous injection of 1 to 3 mg/L (ppm) of chlorine into the mainline upstream of the filter is a very effective means of combating algae growth and bacterial deposition of red iron sludge in laterals and emitters.

Strategies

- maintain a residual level of 0.5 to 1 mg free chlorine/L at the furthermost emitter to ensure saturation of the entire system.
- leave chlorinated water in the system at shutdown.
- run the system with chlorinated water for a short time weekly during the 'off' season to stop algae and bacteria developing.
- deliver a slug of 50 to 100 mg/L chlorine into the irrigation system on a monthly basis and before the start of an irrigation season. Do this at the end of an irrigation cycle so that the slug is left in the lines as long as possible (at least 24 hours). Then open the lateral ends and flush the system thoroughly with a nominal concentration of chlorine before starting the next irrigation cycle.

Some growers inject 20 to 30 mg/L chlorine into the system for the last 30 to 60 minutes of irrigation, rather than apply 1 to 3 mg/L continuously. This can be an advantage when using fertilisers that react unfavourably with chlorine. However, this method is usually only practical when using a fully automated irrigation controller.

Chlorine is commonly available in three forms - solid as calcium hypochlorite (chloride of lime); aqueous liquid as sodium hypochlorite (dairy chlor); and pure gaseous chlorine, liquefied in steel pressure cylinders. The last form is the most expensive to install and the work must be done by a licensed gas fitter. However, it is the most economical form overall and should be considered for systems covering more than 10 hectares.

Chlorine injection systems: the gaseous injection system consists of a gas pressure regulator and a flow regulator, and an injector/mixer operated by the water flow in a bypass of plastic tubing (usually high density polythene) with non-metallic fittings. The bypass is commonly installed between the pump discharge and the suction line, to obtain the pressure differential required. Should the suction line be inaccessible, as with deep well or bore hole pumps, a booster pump and the injector are placed in a bypass of the discharge line. The pressure differential created by the booster pump should be at least equal to the discharge line or mainline pressure at the injection point.

Check valves (non-return valves) are used to ensure that there is no backflow into the injection line. The booster pump should be wired in parallel with the main pump motor to ensure that chlorine cannot be injected when the main pump is not operating.

The other two forms of chlorine are injected by metering an aqueous solution of known concentration into the system by means of a bleed-off into the suction line, or by direct pressure injection into the pump discharge or mainline by an electric or hydraulic injector pump.

Injection rate of free chlorine: a chlorine injection system should be designed to achieve 0.5 to 1 mg/L of free chlorine at the furthermost point of the system. The amount of chlorine that needs to be injected into the mainline is equal to the final concentration of say 0.5 mg/L plus a variable amount that is the chlorine demand. The chlorine demand is the amount of chlorine that is absorbed by the impurities present in the water. The chlorine demand cannot be accurately calculated; it is normal practice to start with a concentration of 1 to 3 mg/L, depending on organic load in the water supply.

Example: for an initial concentration of 1 mg/L and a flow rate of 10 l/s:

injection rate of free chlorine = 10 (l/s) multiplied by 3600 multiplied by 1 (mg/L) divided by 1,000,000 = 0.036 kg/hr

(Note: 1 litre of water weighs 1 kilogram).

Concentration of aqueous solutions: if calcium or sodium hypochlorite is being used, the injection rate is usually set as a round figure. A figure of 4 l/hr is common, particularly when using a micro-tube metering system. In the example, the concentration of free chlorine in the aqueous solution needs to be: 0.036 divided by 4 = 0.009 kg/L or 0.9 per cent.

The calcium hypochlorite commonly available is termed 70/30 hypochlorite or 70 per cent chlorine and 30 per cent lime. However, only about 50 per cent by weight is available as free chlorine when fresh calcium hypochlorite is made up in solution and much less than this if it is not fresh. Sodium hypochlorite has a free chlorine concentration of 10 per cent and is fairly stable at this concentration.

Dose rate: in our example, the required concentration of hypochlorite (not the free chlorine concentration) or dose rate:

= required solution concentration (%) multiplied by 100 divided by percentage free chlorine in hypochlorite

0.9 x 100 divided by 50 = 1.8 per cent, that is 0.018 kg/L for calcium hypochlorite;

or = 0.9 multiplied by 100 divided by 10 = 9 per cent, that is, 90 mL/L for sodium hypochlorite.

Next, calculate the minimum drum size for the chlorine solution. In our example, we are irrigating four blocks with five hours watering per block, doing 2 x 5 hour shifts per night for two nights.

To supply enough chlorine solution for the complete cycle, 20 hours' operation, the minimum tank value:

= hours multiplied by injection rate = 20 multiplied by 4 = 80 litres.

Tank dose: finally, calculate the dose to be added to the tank. For calcium hypochlorite, dose 0.018 multiplied by 80 =1.44 kg. For sodium hvpochlorite, dose 0.090 multiplied by 80 = 7.2 L.

Safety: in its free state, chlorine is a very toxic and corrosive gas, so always provide adequate ventilation when handling any form of chlorine. Chlorine also dramatically increases the combustibility of materials with which it comes into contact, so remove any combustible material from areas where it is being stored or handled.

Best practice information has been obtained from Agriculture WA, Hardie Micro-irrigation Design Manual *by M J Boswell,* Fertigation *by C Burt, K O'Connor and T Ruehr and the Netafim Australia Drip Irrigation Maintenance Manual and is gratefully acknowledged.*

For more details contact Growcom on 07 3620 3844.

Table 1: chlorination interval guidelines

Water source	Chlorination interval
Rivers, creeks or canals which are slow flowing	9 months
Dams/lagoons in a cold climate where the pumping point is properly placed, considering winds and sedimentation	6 months
Effluent water after effective sedimentation and complete biological treatment	Weekly
Rivers, creeks or canals found in hot climates with increased biological growth and no chemical treatment	3 months
Dams/lagoons in a hot climate. Poor placement of the pumping in the direction of the winds with little or no sedimentation or a soluble content that enables the development of a high organic load.	2 months
Effluent water after effective sedimentation with little or no biological treatment	2 to 3 days
Rivers, creeks or canals affected by flood flows and lacking sedimentation facilities	Monthly
Dams/lagoons where the water source has mixed with effluent/flood waters and pumping point is poorly placed.	Fortnightly
Effluent water without sedimentation due to water flow and oxygen added.	Daily

A Growcom project conducted in collaboration with the Queensland Department of Agriculture, Fisheries and Forestry and the National Centre for Engineering in Agriculture with funding provided by the Queensland Government's Rural Water Use Efficiency Initiative.