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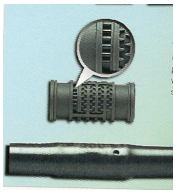
Agri-treat

A revolutionary new water disinfectant for cleaning all irrigation applications

By Gerd Borchers

A farmer's guide for the maintenance of:

Drip lines



Mini sprinklers

Filters

I N D E X

A GUIDE TO DRIP LINE MAINTENANCE

1. INTRODUCTION

a. References to blocked drippers are normally misguided. All emitters become clogged and over a period of time without proper maintenance the mechanisms designed to evenly distribute the water flow become impaired, resulting in some emitters delivering much more water than designed to i.e. up to 100% more and other emitters much less i.e. zero delivery. The unevenness of the distribution is normally more costly to the farmer than the "blocked dripper" which always elicits an immediate management response.

b. Pure water is a misnomer and in irrigation terms does not exist. Water always has a history and water always carries its history wherever it goes. Rain water falling through the air collects impurities from the air as it falls, borehole water minerals as it seeps into the underground and dams, rivers and streams come into contact with any number of substances, man made and other. These impurities carried by the water either as organic or inorganic material all contrives to the clogging of the emitters.

   Unless properly understood and managed these impurities will end up as sediment in the emitters or food for the organisms which grow and multiply to fowl the emitters. Melting snow would probably be the purest form of water, an unknown luxury to most irrigation farmers.

c. As 97% of the chemical requirements of most plants are H^2O commercial agriculture must rely on the even, timeous and reliable supply of these elements as one of the more important management functions.

2. WATER SOURCES

a. Rivers

Rivers are the highways of the water world. The content of the impurities they carry vary widely from almost nothing to very high levels of industrial, city and agricultural waste.

For many years rivers have been used as dustbins and the legacy of this practice is to be found almost everywhere in the environment and as agriculture is the biggest user of water farmers are affected negatively. High levels of inorganic matter such as clay and silt are common as well as high organic content in river water.

b. Dams and lakes

Dams and lakes are affected by seasonal changes as well as the depth of the water. The point where the irrigation water is drawn from will have an effect on the water quality. Too deep and the water may have a high mineral content such as iron and manganese. The decrease of oxygen at lower levels can cause the production of hydrogen sulfide and other metabolic intermediates.

Water drawn too shallow will be high in algae. There is an optimum depth just below the algae concentrations from which to irrigate from.

c. Boreholes

Borehole water is characterized by low organic content and very high mineral and sand content. High levels of iron, manganese, hydrogen sulfide, sulfates and carbonates are common, all of which can lead to problems in the irrigation system.

d. Effluent

In many parts of the world treated sewage is used successfully for irrigation. The parameters of this practice are so varied and complex that this water should be handled separately as a paper of its own. Successful irrigation with this water is possible but at higher treatment costs.

3. WATER QUALITY.

a. Most farmers find themselves with a given water quality on a farm with an irrigation history. Assuming that the water is suitable for irrigation purposes the function of management is to minimize the negative characteristics of the given situation.

This can be achieved by understanding and managing the following:-

i. Filtration: The removal of inorganic matter.

ii. Soft blockages: Living organisms which grow in the pipes and emitters, clogging the labyrinth and affecting the operation of the compensating membrane.

iii. Hard blockages: Sediments found in the emitters caused by an accumulation of deposits of inorganic particles too small to be filtered out or from a chemical reaction which take place when these different elements come into contact with each other under different conditions i.e. temperature and pH.

It is a common characteristic of most farm operations that most situations can be economically controlled given the correct and timeous management inputs.

Table 1. A water classification system for indicating clogging potential in drip irrigation systems. (Bucks and Nakayama 1980)

Clogging Factors	**Clogging Hazard**		
	Minor	**Moderate**	**Severe**
Physical			
Suspended Solids[1]	50	50-100	100
Chemical			
pH	7.0	7.0-8.0	8.0
Dissolved Solids[1]	500	500-2.000	2.000
Manganese[1]	0.1	0.0-1.5	1.5
Total iron[1]	0.2	0.2-1.5	1.5
Hydrogen sulfide[1]	0.2	0.2-2.0	2.0
Biological			
Bacterial population[2]	10.000	10.000-50.000	50.000

NOTES:

1. Maximum measured concentration from a representative number of water samples, using standard procedures for analysis (gm/ℓ)

2.Maximum number of bacteria per milliliter. Can be obtained from portable field samplers and laboratory analysis. Bacterial populations reflect increased algae and microbial nutrients.

4. EMITTER CLOGGING

a. Filtration

This is best left to irrigation engineers, only to stress that the filtration unit is the heart of any irrigation system. The management and operation of the filtering efficiency is absolutely crucial to all drip systems performance.

b. Soft blockages

Identified as living organisms which thrive and multiply at a very rapid rate in the irrigation system. i.e. filters, especially sand filters, mother lines, laterals and emitters, particularly the floating membranes in pressure compensated drippers.

This organic growth is determined by many factors i.e. availability of nutrients and temperature. These living organisms are commonly referred to in the irrigation industry as algal and bacterial slimes and their growth, multiplication and development are totally subjected to van der Hofft's law which states that microbial growth will either double or halve with every 10º change in temperature.

These slimes are grown as a protective covering by the algae and bacteria. As these slimes are sticky and tacky they collect inorganic material which flows past such as iron, manganese, silt, clay and undisolved fertilizers.

Bacterial counts of less than 10 000 per milliliter would be considered a low clogging hazard while counts of 50 000 and more would be considered a high hazard. Populations counted in the millions are most common.

c. Hard Blockages

Sedimentation will occur at high levels of inorganic content in the water, especially as the water velocity drops towards the end of the laterals and in the emitter labyrinth. pH levels above 8 will add to this sedimentation process. Water temperature also plays a role. As cold waters contain more carbon dioxide they are more prone to carbonate sedimentation.

In practice it is very common that the emitter's delivery is affected by a combination of all of the above factors. In the great majority of cases if the algal and bacterial slimes can be removed from the

system the inorganic materials pass through the emitters and cause no further problems

5. CHEMICAL TREATMENT

Any chemical used regularly to clean irrigation systems must have certain characteristics and conform to certain standards.

The minimum requirements would be:

a. Its use must be safe to the operator and environment.

b. It should not affect the crop in any way.

c. It should not kill the soil organisms growing in the root zone of the crop being irrigated.

d. The product must have EUROPGAP accreditation.

e. The product must not cause resistance of the bacteria being controlled.

f. The product must be safe should the treated water be consumed by animals or humans.

g. The product must not in any way affect the material used in the compensating membrane.

Comparison between the various chemicals for cleaning irrigation drip-lines

	Feature \ Chemical		Chlorine	Agritreat	Hydrogen Peroxide
1	Effectiveness at different PH levels	pH5	effective	effective	effective
		pH7	Ineffective	effective	effective
		pH8	Ineffective	effective	effective
2	Environmentally friendly ?		No	Yes	No
3	Can it cause damage to crops ?		Yes	No	Yes
4	Can it cause damage to soil organism ?		Yes	No	Yes
5	Potential for resistance		Low	Low	High
6	Safe for humans and animals ?		Dangerous	Safe	Dangerous
7	Can the chemical erode metal components in the irrigation system ?		Yes	No	Yes
8	Is the Chemical EUROGAP approved ?		No	Yes	No
9	How long must the chemical be in the line		12 hours	15 min	24 hours
10	Can you continue to irrigate while application takes place		No	Yes	No
11	Does product affect the growing tip of roothairs		No	No	Yes
12	Can the product buildup in the soil		Yes	No	No
13	Does the product need the pH of the water to be adjusted		Yes	No	No

6. FILTER CLEANING

i. Sand Filters

Regular disinfection of bacteria from the filter is necessary. Apply 2ℓ of Filter Treat 400 to a 48" sand filter as follows:

a. Backwash filter well
b. Isolate filter unit by closing valves to the filter
c. Open filter lid.
d. Apply 2ℓ of Filter Treat 400 per 48" filter
e. Leave overnight and back wash thoroughly.

ii. Disk and screen filters

It is important to remove all growing organisms and inorganic material which has adhered to the disks or screens over a period of time during the irrigation process. Follow the steps indicated.

a. Remove the disks or screens from the filter.

b. Take a container large enough to accommodate all of the discs, screens or parts that need to be cleaned.

c. Make a concentration of 20% IDS Acid with enough water to cover all the parts. Leave the parts for a few hours immersed in this concentration.

d. Remove the parts from the solution. It maybe necessary to give the treated parts a light scrubbing with a brush to remove some of the hard sediments.

7. MINI SPRINKLERS

The total blockage of mini sprinklers is rare. Uneven distribution caused by restrictions in the sprinkler outlet are very common and is caused mainly by a combination of organic and inorganic material growing and accumulating in the water passages designed to deliver an even flow.

In most cases these restrictions are caused by a hard carbonate buildup which accumulate over time on the algal and bacterial slimes which grow in these water passages. This causes a restriction which affects the even delivery.

Application of AgriTreat 300 at 500ml per 10^3meters per hour for 20 to 30 minutes should remedy this situation. The shortened application time is due to the greater water velocity passing through the water passages and removing the materials quickly under pressure.

8. SOFT BLOCKAGES

This refers totally to the growing organisms and the sticky slimes which they produce to cover themselves with as a form of protection. The correct application of the chemical must eliminate the bacteria and cause them to be flushed from the system all of this organic material will form part of the food source for the next generation of organisms. After chemical treatment the flushing of the laterals cannot be over emphasized.

A. AGRITREAT 300

This is a potassium based product with an active ingredient of stabilized hyperbromus acid. This product owes its origin to the potable water (drinking water) industry and meets the requirements of the E.P.A. (Environmental Protection Agency) and the F.D.A. (Food and Drug Administration) for potable water. AgriTreat 300 has been accredited by Europgap.

Effect on Plants

The product is applied at very low concentrations of active ingredient. No detrimental effects have been recorded when used as recommended.

Application

a. Irrigation System.
The application of AgriTreat 300 can be done in a number of ways.

i. Corrective application
Apply 500ml AgriTreat 300 per 10^3meters of water per hour for 1 hour. Apply every second day, flushing laterals every other day until irrigation system delivers according to design criteria.

ii. Intermittent Application.
Apply 500ml AgriTreat 300 per 10^3meters of water per hour for 1 hour when water volume delivery drops by more than 2½% according to design specifications. Repeat when necessary. The frequency of these applications will be determined by many factors i.e. season, source of water, temperature, pH, bacterial load and the standard required by the farmer.

iii. Continuous application
Some irrigators have a preference for a continuous application because it does have advantages.

Apply a continuous dose of 0.2ppm of free Br^2 into the system while irrigating. It is also advisable to give special attention to disinfecting the sand filters using Filter Treat 400, especially in the summer.

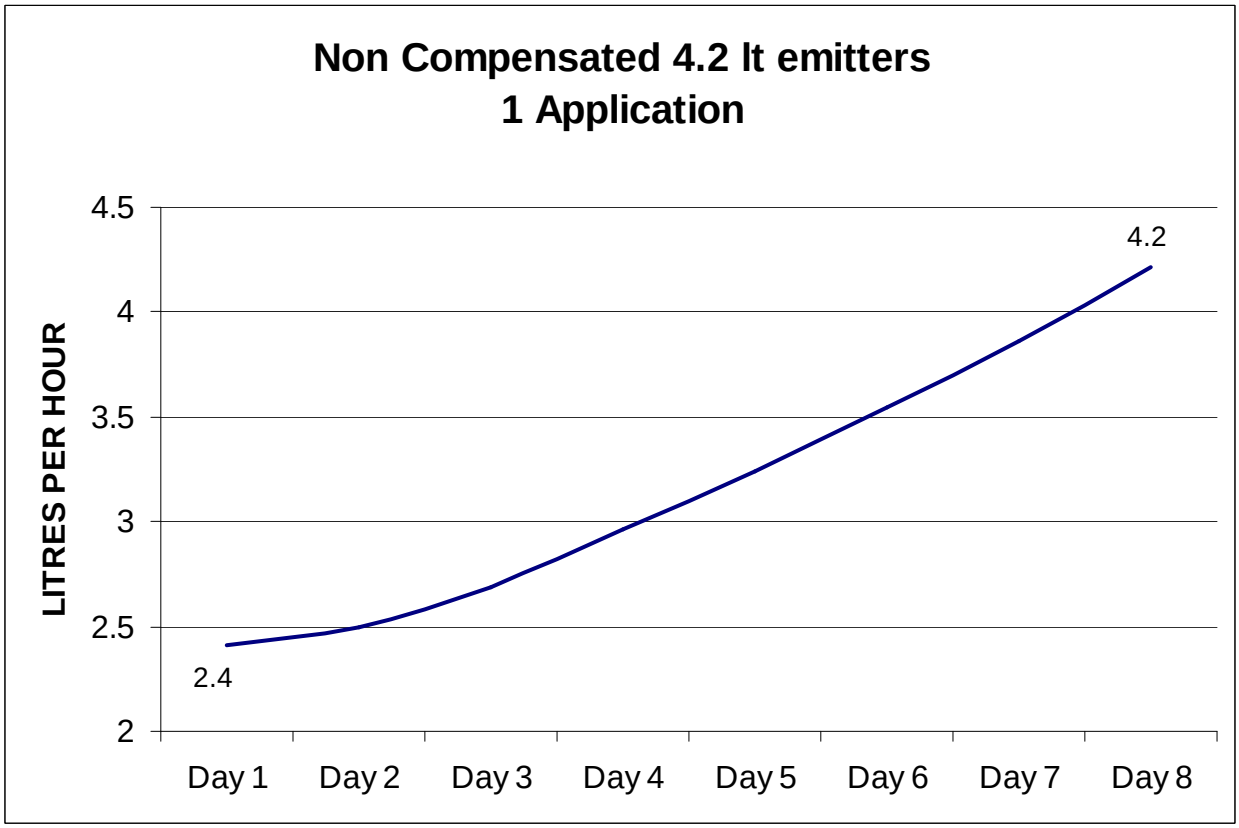
When using recycled sewage water continuous application is necessary as the bacterial loading of the water is so high that other methods just do not work. If sewage effluent is used the dose applied will be determined by the bacterial load and the length of the pipes in the irrigation system to be cleaned.

N.B. AgriTreat 300 leaves no residue in the pipes so bacteria start to grow immediately after application ceases. After application the flushing of laterals is very important. See Chapter 6 on Soft Blockages.

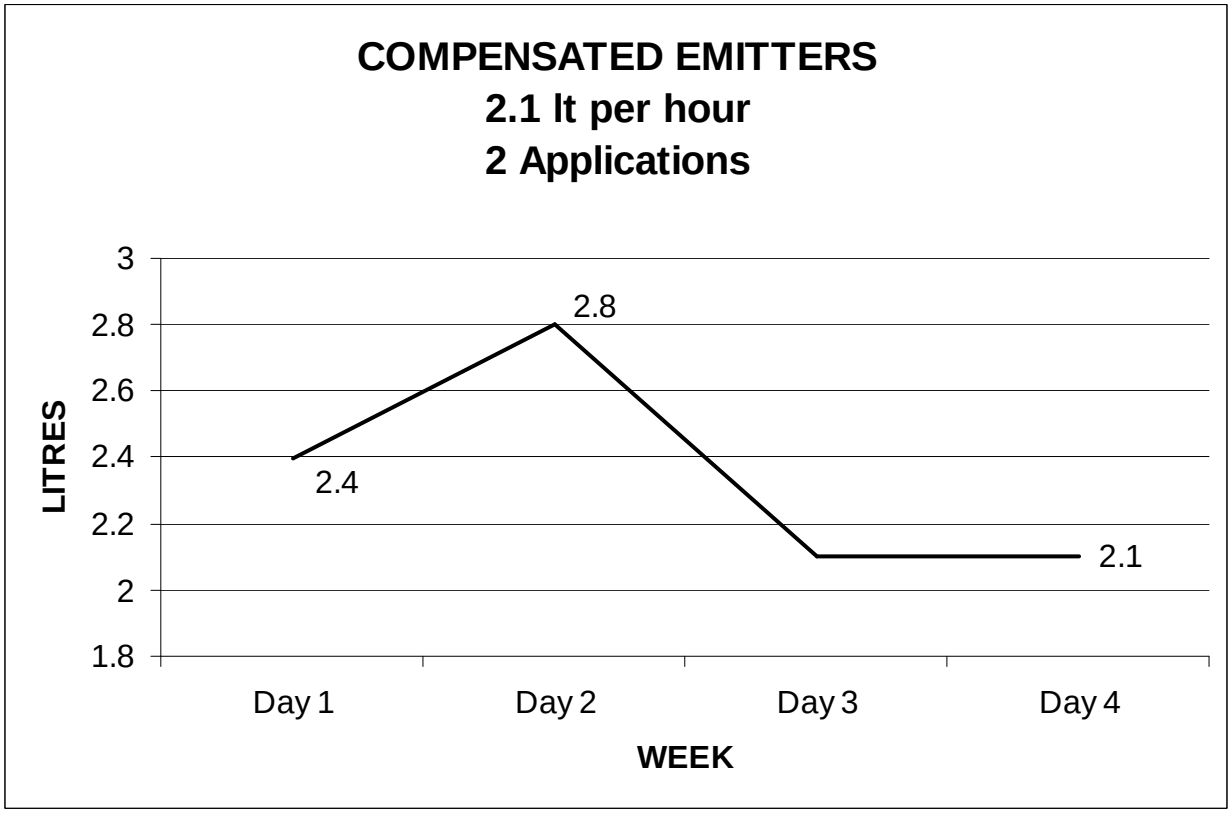
B. RESULTS USING AGRITREAT 300

The product is applied for 1 hour during the normal irrigation cycle. A very quick kill of the bacteria i.e. 2 or 3 minutes means that the dead bacteria are removed from the system during the same irrigation cycle.

Careful measurement of water flows and pressures during treatment show that different drippers behave differently during the disinfection process.



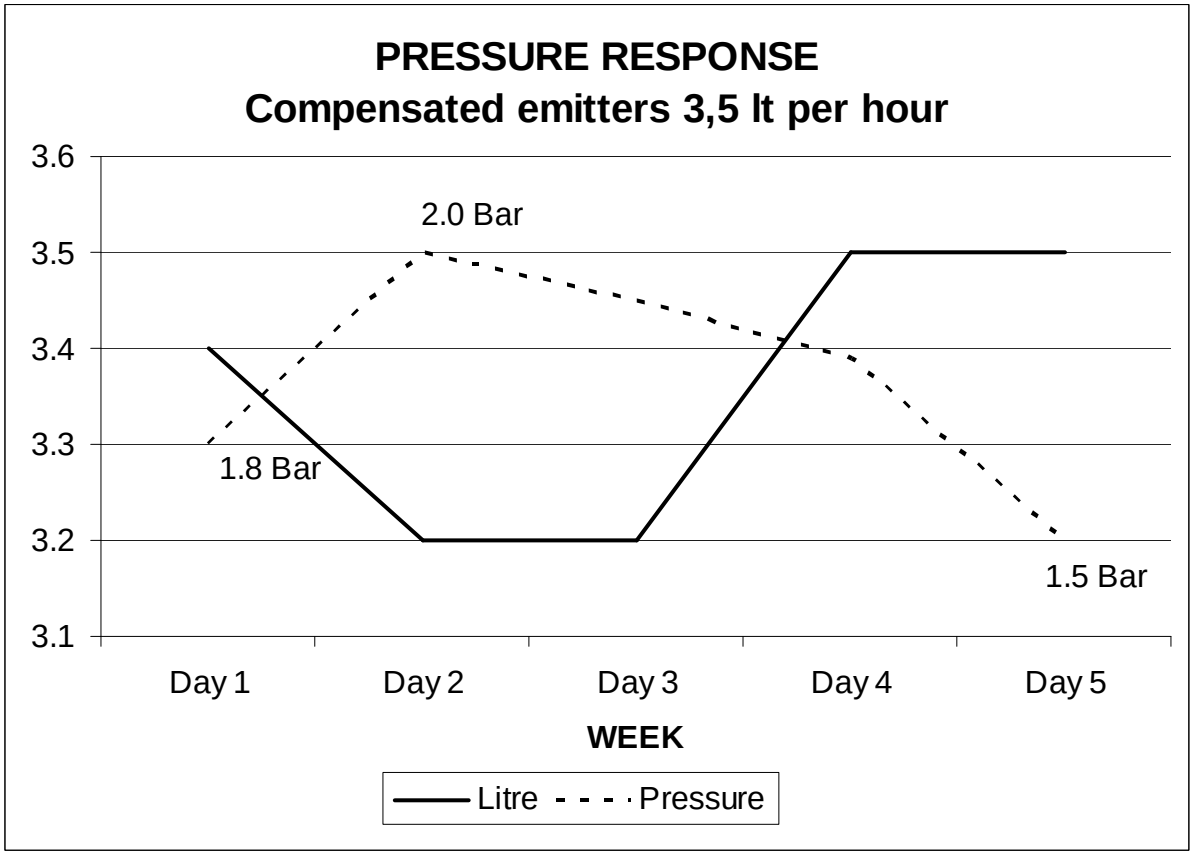
Emitters with a large delivery are much easier to clean than those with a small delivery. It is necessary to use the water flow to remove the treated bacteria; this in severe cases may take a few days and a number of irrigation cycles to achieve.



Some emitters become clogged by soft blockages in the open position thus delivering more water than it is designed to. During the 1 hour of treatment delivery may even increase before fowling is killed and flushed out of the emitters, when volume will decrease to the design specifications.

C. Pressure Response.

It is interesting to note the pressure response in the emitter as the bacteria are killed and removed.



This graph shows the response of the emitter compensating membranes to an AgriTreat 300 treatment in a citrus orchard.

The average delivery of the 100 emitters was not far off the design specifications. As soon as the AgriTreat was applied and the bacteria and slimes clogging the emitters were killed off and flushed out the average of the 100 emitters start to deliver much less than designed. At this point pressure starts to increase. During the 1 hour of treatment this tendency continues with pressure rising and water volume reducing.

The cause of this is that before treatment started some emitters were clogged in the open position delivering more water than designed while some emitters were clogged in the closed position delivering much less than designed. The membranes in the open position receive more water flow and therefore more AgriTreat so the kill rate is quicker, the water flow is stronger and the dead organisms are removed relatively quickly. As the membranes clogged in the

open position clear and deliver the correct amount of water per dripper the average volume over the 100 drippers reduces, all the time the pressure rises.

This tendency continues until such time as the drippers clogged in the closed position start to clear and deliver more water per dripper. The average delivery for the 100 dripper's increases and the pressure starts to drop.

The final result measured 2 days later shows that design criteria of 3,5ℓ per hour has been achieved. More water has been moved at a lower pressure than when the AgriTreat disinfection started indicating that evenness of distribution has been achieved.

9. APPLICATION EQUIPMENT

Any form of application equipment which will deliver an even concentration of AgriTreat 300 can be used.

The manufacturers of AgriTreat 300 supply application equipment custom built for various requirements which can be hired or bought from IDS Aquaduct (Pty) Ltd.

i. Model A.T.1
   a. Manual on off switch
   b. Electric 220v pump. Capacity 250ml to 2ℓ per hour delivery
   c. Pump set manually by operator.

ii. Model R.T.1
   a. Electric 220v pump. Capacity 250ml to 2ℓ per hour delivery
   b. Sensors when line is irrigating
   c. Records number of hours irrigated.
   d. Automatically starts application after pre set number of irrigation cycles has been achieved.
   e. Early warning system of product level.

iii. Model G.B.1
   a. Electric 220v pump. Capacity 250ml-2ℓ per hour delivery
   b. Sensors when line is irrigating.
   c. Records number of hours irrigated.
   d. Monitors and records water flow.
   e. Automatically starts application at pre set number of irrigation cycles or volume of water irrigated.
   f. Records tank volume.
   g. Downloads information on request from computer or cell phone.

Advantages and Disadvantage of AgriTreat 300

a. These products are designed specifically for the irrigation industry.

b. They are not pH sensitive.

c. They have EUROPGAP accreditation for this use.

d. Very low levels of active ingredient are applied i.e. less than 0.2 ppm which is destroyed rapidly on contact with sunlight, soil etc.

e. Even at high concentrations this product has no or little effect on soil organisms.

f. The product is safe and environmentally friendly.

g. Does not damage the compensating membrane when used according to manufacturer's recommendations.

h. AgriTreat 300 does not degrade until it comes into contact with sunlight or soil so the dose applied stays reasonably constant until the last emitter, ensuring cleaning of the emitters at the furtherest point in the land.

i. The biggest disadvantage is that such small quantities of active ingredient are applied that special care must be taken while treating a system.

10. **HARD BLOCKAGES**

a. Acid is used for this treatment. One of the following products can be used:

a. Hydrochloric acid (HCL)
b. Phosphoric acid (H_3PO_4)
c. Sulfuric acid (H_2SO_4)
d. Nitric acid (HNO_3)

Treatment with acid.
Acid is applied to irrigation water to perform a number of functions.

a. Dissolve existing sediments.
b. Adjust the water pH to improve the efficiency of the chlorine.

b. Method of application.

Injection of acid is normally done as the need arises and is considered not to be detrimental to the plants treated. Due to the large volume of chemical used to obtain good results care must be taken to ensure that the crop is not affected. It is not recorded what effect acid has on the material used in the compensating membrane. Contact the drip line manufacturer for compatibility on this subject.

1. Enough acid must be applied to the irrigation water to reduce the pH to 2 at the furtherest emitters.

2. Fill the whole irrigation system with this concentration.

3. The treated water must be left in the laterals for 60-90 minutes and then the system must be flushed thoroughly.

4. Repeat this procedure until adequate results are obtained.

11. DISINFECTION POTENTIAL COMPARISON

a. AgriTreat 300 versus Chlorine

Oxidation occurs rapidly with the resultant loss of disinfection. Very high application of chlorine is required at the beginning of the system to ensure enough disinfection at the end of the system. This oxidation is unavoidable and depends on water quality, length of irrigation piping and duration of flow.

Table: Diminishing oxidation of chlorine in potable water.

Residuals measured as ppm

Application	4.7ppm	2.5	0.14	0.03
	4.7	2.75	0.14	0.00
	4.7	2.5	0.16	0.06

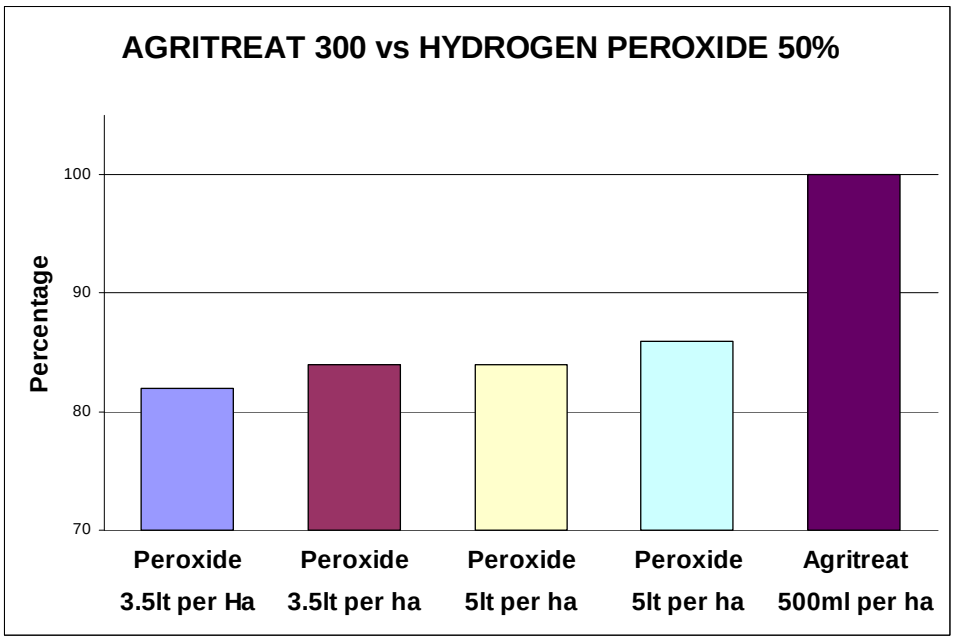
Table: Diminishing AgriTreat 300 residuals
Residuals measured as ppm

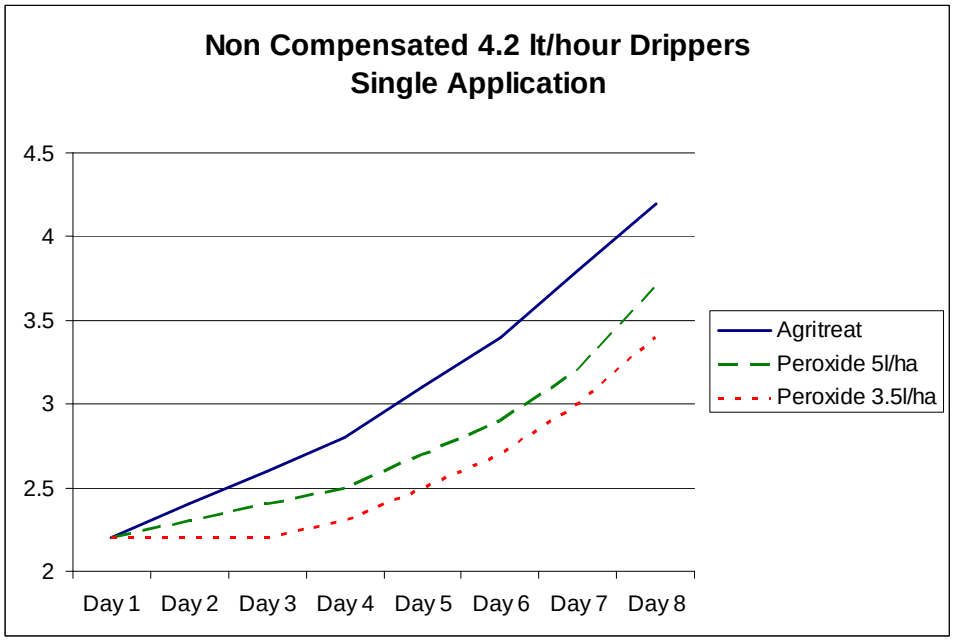
Application	0.8ppm	0.63	0.41	0.21
	0.8	0.52	0.41	0.35
	0.8	0.58	0.26	0.24

Provided AgriTreat 300 is kept away from sunlight and soil it oxidizes slowly therefore ensuring that even with a low application at the start of the system disinfection potential lasts much longer to ensure control throughout the system.

Disinfection Potential Comparison

b. AgriTreat 300 versus Hydrogen Peroxide 50%





12. FIELD RESULTS

A typical result of a commercial application of emitters with compensating membranes using AgriTreat 300 @ 500ml per 10m³ water where the membranes were clogged in an open position leading to very uneven delivery.

Application Time In minutes	Delivery	Pressure
0	330	2 Bar
1	320	2.1
2	320	2.3
3	310	2.4
4	320	2.5
5	300	2.4
6	300	2.5
7	290	2.5
11	300	2.5
13	290	2.5
14	290	2.5
16	300	2.5
17	290	2.5
19	300	2.5
21	290	2.6
23	290	2.6
27	290	2.65
33	290	2.75
37	285	2.85
38	285	2.95
40	285	2.95
44	285	2.95
45	285	3.1
60	285	3.1

Netafim Ram P.C. emitters.
Design criteria 1,2ℓ/hour.
Start 1.5ℓ/hour
End 1.2ℓ/hour

Comment:

a. The average delivery over the 220 emitters showed a very uneven distribution with the average delivery 25% more than design specification.

b. In the first 20 minutes of application the delivery drops by 12% while pressure increases by 20%

c. In the last 30 minutes of application delivery stabilizes according to design specifications while the pressure continues to rise indicating that the compensating membranes are free of clogging and are still in a good working condition.

d. Note how 66% of the cleaning process takes place in the first 5 minutes of application. 88% of the cleaning in the first 25 minutes of application indicating clearly that living organisms are the cause of the fowling in the compensating membranes and that they are quickly controlled and removed.