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Using Recycled Water in Drip Irrigation in Commercial and Residential Applications

Water supplies are under assault from all fronts. The quality of ground is getting progressively worse. Contamination of water supplies limits the usability water. The availability of water fluctuates depending on the areas of the country, rainfall, etc. New sources of water are needed where groundwater supplies are lacking. Water districts and states are involved in court cases spread out over many years to determine the ownership and usage of water sources. Thus, using recycled water and dispersing it in a safe manner has become even more imperative. Technology has been developed that is using water from waste plants and septic systems. This water is used for commercial, industrial, and residential uses. Water quality is a vital issue whether in small (200-400 gpd) to large systems using 10-15 million gpd. Using recycled water is becoming more necessary.

Drip irrigation is one of the methods of irrigation for tree farms, row crops, nurseries, and other applications. Drip irrigation may become the preferred method for discharging the water into landscape.

Before using recycled water several issues must be addressed. (1) Preparing the water for discharge and use meeting or surpassing government guidelines (2) filtration (3) controlling the level of pathogens and organic growths, and (4) keeping drip irrigation lines open to keep the flow consistent and continuous.

As the population grows, the volume of water in waste plants increases and this increase results in a reduction of water quality effluent from these plants. While growth in population increases the revenue, the increase in water throughput can result in a poorer water quality which has had detrimental effect on recycled water being used. There are various types of processes in waste treatment plants, but when the throughput is increased beyond the capacity of the plant, water quality suffers.

Filtration for recycled water should always consider sand media filters. Problems generally encountered with recycled water are organic contamination and the rich nutrient base. Sand filters have proven to be better at trapping and removing organic contamination. Filtration should be in the range of 100 - 200 mesh or 80 to 165 microns.

Organic materials are the major threat in using recycled water in irrigation systems. Algae, bacteria, viruses, molds, mildews, slimes, and other organics can grow within the system. Drip tubes can easily plug with organic matter. Another situation occurs when a small piece of organic matter snags somewhere in a valve, fitting, emitter, or sprinkler. The organic matter by itself may not be large enough to be a problem. But soon another piece comes along and gets

caught in the first. Then a very small grain of sand or organic particle that would normally have passed through the system without problems becomes caught in the organic matter. Soon a large build-up of crud forms and the flow is blocked. Have you ever had the hose on your vacuum cleaner clog up with a wad of hair, small objects, and dirt? Each one of those objects went into the hose, so they should have made it through to the canister. But they didn't because they all got caught together. The same thing happens in your irrigation system.

Using recycled water in irrigation has increased the amount of organic growths in the system. This is due to the higher volume of organics and the rich nutrient base in the water. Chlorine, UV, and ozone have been used in these waste plants in an attempt to disinfect the water. They have all been poor in removing and preventing organic growths. Using the same processes in the field will not provide any better results. Products have been developed for cleaning and removing organics from the irrigation system and these products can be injected into a system to prevent growths from forming in the first place. Dosages vary depending on the quality of water, volume, amount of contamination, temperature, layout of system, pH, and other factors.

Efforts have been made to treat the water mechanically to remove more of the nutrients before being introduced into the irrigation system. Softening, RO, and other processes have proven to be costly. The disposal of the backwash, the use of brine solutions, and acid and astatic regeneration solutions present their own problems. Some growers have tried using several different types of filtration in the same field. This has worked fairly well with ground water, but not with recycled water.

State guidelines vary from state to state and are constantly change due to federal, state, and local regulations being updated and revised. Trends in the industry have changed from adding ammonia compounds in combination with chlorine to discharge water to today's standard of chlorinating and then de-chlorinating before discharge. Disinfection methods have changed and are implemented in the field. Some methods of disinfection work well in the laboratory and then perform poorly in the field.

In some areas of the country, fish are not even considered safe to eat that are caught in rivers, ponds, and oceans. Fish have sought farther off shore. Off shore fishing boats now go 25 to 50 miles offshore in search of fish. There may be a link with lower water quality of discharge from waste treatment plants.

With the poorer water quality, recycled water is more of a problem to use. More treatment is required in the field to make the water usable. There are more problems with drip lines plugging. When the drip lines plug, the pressure increases and the volume of output decreases.

Case Study Large Tree Farm

Results using recycled water have been promising as a method of discharging waste water into the ground and restoring the aquifer. The plant is under federal mandate to begin eliminating discharge into the local river. This tree farm is to begin to reduce the discharge into the river and begin alternative disposal method.

This tree farm irrigates 720 acres of cottonwood and sycamore trees. These trees were selected because of the large volume of water that the trees can consume and their ability to withstand the water discharged. Trees are grown with the idea of selling the wood after 7 to 10 years. The agency is hoping to break even with the project (cover costs with the proceeds from the sale of the timber). The tree farm has been in operation for four years. Trees now range in height from 10 to 25 feet tall, average circumference of tree is 6 to 8 inches. Trees have proven to be hardy, resistant to disease and less than 3 % have died in four years.

Tree Farm Data

1,250 gpm flow rate

720 acres total

16 zones of approximate equal size

2 zones water per day for 24 hours, then rotated to other zones

90 acres per day irrigated, approximate

1,800,000 gals per day of irrigation water for 90 acres

20,000 gals per acre per day

Water for this tree farm is from a regional waste treatment plant. Currently irrigating with 1.8 mgpd and will eventually grow to 5.6 mgpd of waste water recycling. The water for the tree farm is chlorinated at 5 to 6 ppm at the plant, fed through a sand filter, then pumped six miles to the receiving plant. The chlorine level drops to 0.3 to 1.5 ppm on the way to the receiving station. De-chlorination occurs before being sent to the tree farm.

This tree farm has run exceptionally well for the four years of operation. Maintenance of equipment has been low and after the initial cost of set up, costs of operating the system is low with few employees required to maintain the system.

Results have been very good and have been what was as proposed by the engineering firm that designed the project. Organic material is starting to build up and become a problem. Algae is visible on the ground where the drippers are open. The majority of drippers are open and working properly although 30% and 40% are blocked with organic growths. When the end of the drip tubes are opened, a black liquid is expelled that has a putrid odor. This liquid is a combination of fecal material and organic growths. In order to continue the tree farm in the future, removal of the organics with a product such as Line Blaster will be necessary. If not, the drip lines will need to be replaced within the next year. The cost of replacing the drip lines is tenfold higher than cleaning up the existing system. Studies are ongoing and recommendations are being made to clean up the system. The agency is weighing costs and treatment options. Results will be reported as ongoing treatments are implemented.

Case Study Small Package Plant

The small package plant was designed to handle a maximum of 25,000 gpd waste stream from a golf and country club restaurant, clubhouse, and office building. Plant throughput is currently 6,000 to 8,000 gpd. Discharge up to 25,000 gallons per day from the holding pond. The holding pond before discharge can contain up to 3.8 million gallons of water. Currently holding 1.4 million gallons in holding pond. Plant has Ultra Violet (UV) light installed as disinfection before final discharge. The plant has excellent controls and the operator is very well trained in handling the plant.

The final stage before discharge to a holding pond is the mixing chamber. The mixing chamber measures 8' x 12' x 20'. UV light is employed as the final step before discharge to the holding pond.

The holding pond is 65' x 480' and depth varies between 6 and 12 feet. At the far end of the pond, the discharge valve is on the bottom of the pond. Discharge is to drip lines buried in the ground in a wooded area along side of the golf course. There are 8 zones and discharge to the different zones is controlled by timer. The drip lines used contain a "disinfection" lining that is claimed to prevent the growth of organics.

This small package plant has performed fairly well as designed, but several problems have arisen that need to be addressed. In the mixing chamber, a large mass of algae had coated the walls, floor, vessels, equipment, piping, etc. Visibility in the chamber was only to a depth 2 to 4 ft. as the algae's color tinted the water a bright green. The mass had grown so large that at times the UV bulbs were covered with algae that light was not able to be transmitted into the water. The bulbs had to be physically cleaned to remove the build up. Chlorine tablets were added to the chamber to control the algae. Tubes were installed in the inlet flow that would slowly dissolve the tablets. This was still ineffective and did not control the algae. The operator at times would add powdered pool chlorine in a "shock" treatment to remove some of the algae. The treatment would be effective for 7 to 10 days, then the algae bloom would occur again and it wouldn't be much better than before. After two weeks, the mass was thick enough to cover the bulbs again and require treatment.

The algae was a problem not only in the mixing chamber, it has spread to the holding pond and growth of algae has been prolific. The holding pond was a bright green color from one end to the other. It had gotten so bad that the discharge pipe was plugged with algae. Another pipe was installed to by-pass the previous suction pipe. It was laid on the ground and over the bank and run to the irrigation pump. This was not approved by the state, but was added until the normal discharge pipe could be cleaned or replaced.

The drip lines also had a green growth in the tubes. It has not gotten to the point where it has plugged the drippers.

After assessing the situation and observing operations at the plant, several options were recommended to begin feeding an organic cleaner to remove the algae. Treatment was determined to require 200 ppm of treatment to be fed once per day in a dosage of 18 ozs. fed as the water entered into the mixing chamber. On the first day of treatment, masses of algae began sloughing off the sides and floating on the surface. After several hours, the masses began turning an off-white greyish color and then they would disappear after 24 hours. In six

weeks, the chamber had been completely cleaned and the bottom of the mixing chamber was easily visible. In fact, the operator collected a set of keys that he had dropped into the chamber several months before.

The next step was clean up the discharge tube and to clean up the drip lines. There were several options available:

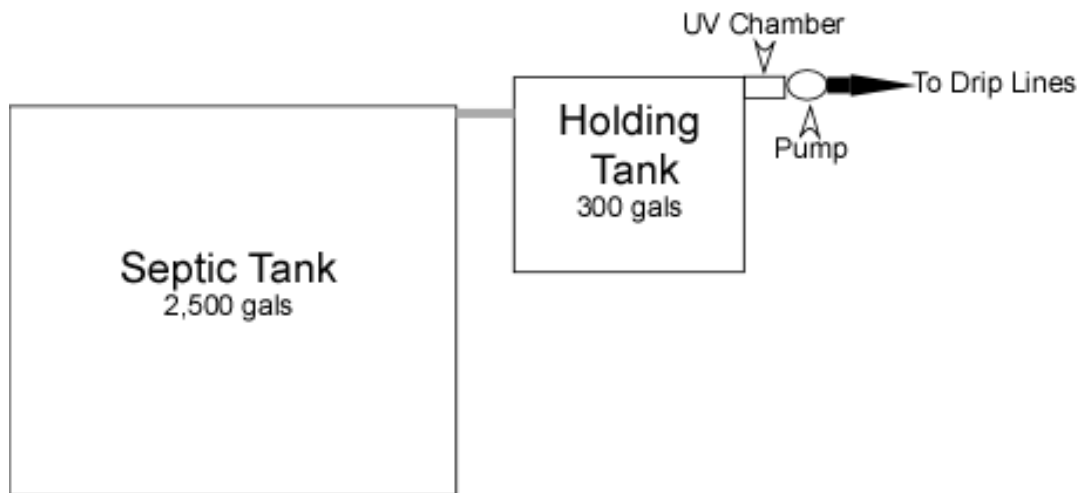
- 1) Add a large amount of treatment into the pond to remove the algae in one quick clean up operation, then begin a maintenance dosage to keep the pond from regrowing as quickly, this option would take a week to clean up the pond and it would also be the more expensive option
- 2) Add a moderate amount of the treatment around the discharge valve to clean out the pipe and to clean out the drip lines. The increase the dosage by a factor of 3 and feed 2 times per week to clean up the pond. This would take 3 to 4 months and is the median cost.
- 3) Increase the treatment level by a factor of 5 and feed the product six times per week to clean up the pond and drip lines. This treatment would take 6 to 12 months to be successful. Lower cost, longer clean up period.

The operator has recommended option #1 to his company and they are reviewing the options and the costs. Clean up will begin once the recommendation is accepted and results of the clean up should be available in the next 30 days and reported at the IA meeting in Nov.

Case Study Residential Septic System

The first of this type of recycled water system has just been installed and has begun operations. The prototype has been approved by the State of North Carolina and has been in operation for less than a month. It is too early to know any results as far as the operation's success, but it is the beginning of a trend to move away from traditional septic systems with drain fields and beginning to use drip irrigation for dispersal of water. Currently it is not approved for use in landscape irrigation, but after proving to be successful, the state will consider approval for landscape irrigation after 2 years of operation.

The septic system consists of the standard 2,500 gallon septic tank which is placed lower in the ground than the standard tank, a 300 gallon holding tank that is above the level of septic tank, and float sensor that empties the tank whenever it reaches 80% of capacity, a UV light for disinfection, and a pump that sends the water into the drip lines buried 18" below the ground to ensure that it doesn't freeze in the winter.



TYPICAL RECYCLED WATER ANALYSIS
7-05-95

Temperature 77°F

	Recycled Water	Domestic Water
P Alkalinity (as CaCO ₃)	0.0	0.0
M Alkalinity (as CaCO ₃)	164.0	124.0
Chlorides (as Cl)	261.6	120.0
Total Hardness	256.0	120.0
Calcium (as CaCO ₃)	160.0	108.0
Magnesium (as MgCO ₃)	96.4	12.0
Silica (as SiO ₂)	17.3	13.5
Sulfate (as SO ₄)	78.2	0.0
pH	6.85	7.68
Conductivity	1200	250
Iron (as Fe)	0.4	0.5
Phosphate (as PO ₄)	4.5	1.6