RECYCLED WATER: HISTORY, USES, COMPOSITION, AND PROBLEMS

I remember when I was young, I used to fish from inner tubes in very shallow water in the Gulf of Mexico. The water was a crystal clear, blue-green and you could see the bottom at a 20 ft depth. My cousin and I would catch fish as long as my arm all day long. It was only a matter of how long we wanted to fish, not whether we would catch any fish. That was forty years ago. Today, if you want to go fishing for big fish, you have to go offshore 50 miles. There used to be an abundance of sea shells on the beaches. We would collect shells to make periwinkle soup. Today there are no more shell on the beaches in America. What happened in 40 years?

HISTORY:

Let's go back and look at the history of waste treatment. When America was first settled, houses were far apart and there weren't any problem with waste disposal until cities began to form. In the urban setting, waste disposal became a serious problem. Previously in Europe, wastes had been poured into the streets which led to serious diseases including the great plague. Open culverts had been used during the Roman Empire for the collection of waste in a central location. Ben Franklin changed this in America in 1870 by using logs that were hollowed out to be used as pipes.

The first waste treatment facilities were simple lagoons located outside of town. These lagoons became a problem as cities began to expand. Odors, overflows from heavy rains and disease were problems that plagued this method. However, this continued to be the normal method of waste disposal until the 1950s. During the 1950's settling tanks, aerators, drying beds, and other contraptions were placed into use. From the 1950s to the 1970's, waste treatment facilities were set up in conjunction with the storm water runoff system. All that was needed to operate the facility was a steady stream of precipitation that would flow through the facility and flush the solids out of the waste treatment plant and into the waterways. The waste treatment facilities normal practice was to dump "*treated water*" into streams, creeks, rivers, oceans, and other waterways. In the 1970's the EPA stepped in and began to require separation of the storm water run off and waste treatment systems. Today that has not been completed in most areas of the country. Most cities still allow storm water runoff to run through the waste treatment facilities and then into the waterways.

With the population explosion in urban areas across the country, many cities quickly found their waste treatment facilities overloaded and with great problems. Instead of increasing the capacity of the waste treatment facilities or building new plants, many waste treatment programs simply decreased the time of treatment and passed the "less treated" "*treated water*" out and into the waterways. Less treatment for more money. Sounds familiar doesn't it? When new waste treatment facilities are built, they are very much like our highways, it's too little too late. The waste treatment facilities are overcapacity as soon as they are finished. Almost no treatment facility has the capacity to allow the wastes to remain in the facility for the time required for effective treatment. However, governments soon found that water and waste treatment were the only areas that produced income. The costs of new facilities and overhead quickly raised the sewer charge. On the average bill, sewer charges quickly doubled, tripled, quadrupled, or went even higher without increasing the effectiveness of the waste treatment facilities. Septic systems were banned in many areas simply to allow governments to collect more money while not showing enough concern for the environment or looking at the long term water supply.

In the 1980s, the EPA increased the number and scope of tests required by treatment facilities. The allegations of heavy metals, pesticides, and other undesirable compounds were discovered in the solids removed from waste treatment facilities. Previously, solids were removed from the waste treatment facilities and placed in pastures, farms, and other areas for organic enrichment of soil. After more than200 years of civilizations placing the waste solids on farmlands, the EPA declared that this practice must cease. With the new testing standards, the EPA began to require that these solids be placed in landfills. Not only was disposing of liquid a problem, but now disposal of the solids also became a problem. **T**his resulted in the cost of treating waste water to go up with no change in the results.

Why is recycled water now of interest to these same with government entities? Why all of a sudden is recycled water important? It's important because they are running out of water. They can't sell water they don't have. Water treatment plants would have been content to dump the waste water into our streams and oceans forever. It's only when America is running out of water thus threatening the income from waste water treatment that recycled water has become an issue.

USES:

RECYCLED WATER SHOULD NEVER, EVER BE INJECTED INTO THE GROUND WATER SUPPLY

Recycled water must be allowed to seep back into the ground in order to naturally replenish the ground water supply. Although septic tanks have been looked down upon as something only country folks have, its design is simple, effective, low cost, and it returns clean water to the aquafer using the ground as an excellent filter to remove solids and organisms. Septic tanks should be become the preferred method of waste treatment and should be used whenever possible. However, with large systems already in place, the water must be disposed of in some manner. Using this water for irrigation is an excellent method of increasing the water supply in the aquifer. Golf courses should be the first priority for use due to the large volume of water that they use and close proximity to populated areas. Some cities have installed recycled water systems and are returning the water to residential and commercial customers for a small monthly fee. Other cities have gone as far as making it mandatory to customers to pay for the service whether they use it or not. Many more are looking into the effectiveness of recycled water for their community.

Agriculture use of recycled water has been spotty due to the distance from the facilities to more rural areas where farms are located. Due to large volume of water consumed and the need for continuous water, agricultural irrigation would be an excellent use of this water. Although treatment would be required in order to use treated water, it would be an excellent way to safely get water back into the aquifer.

WATER SHOULD NEVER, EVER BE INJECTED INTO THE GROUND WATER SUPPLY

Using recycled water in irrigation is an excellent way to return water into the aquifer. The ground works as a great filter for removing the nutrients and organisms found in the "treated water".

RECYCLED WATER QUALITY:

What should we expect from the quality and quantity of waste treatment recycled water? There have been many debates about the usefulness and desirability of using recycled water. Using recycled water never would've been required if we had continued to use septic tanks or waste disposal in residences. One of The most consistent qualities of recycled water is the inconsistency of the water. When considering the quality of the recycled water, all one has to consider is the source. There are two sources to consider in the constituency of recycled water. The makeup water (or source water) and the constituents added by the users (us). Consider all the things that people dump down the drain. Everything from the leftover gravy, chicken and animal fats, other foods and peelings, motor oil, furniture polish, detergents from dishwashers and washing machines, drain openers, shoe polish, paint and thinners as well as the normal load of human wastes. The quality of recycled water will depend on the constituents that are placed in the wastewater stream.

Mineral Content - Typical analysis of recycled water from a mineral content is consistent with the quality of the water that was used as the water source. What this means is that there is a little change to the water's mineral content going through the processes in the waste treatment facilities. There are small changes in the amount of phosphorous, chlorides, and calcium, but overall the mineral content remains unchanged in the treatment process. Slight increases and variations are to be expected but there should not be a significant change in the mineral content of recycled water as it relates to irrigation. A typical recycled water analysis from Tampa FL is listed below. All of the constituents are soluble and there isn't any noticeable precipitation. The "gray" water label has to do with the color of the water and not the content. While there are higher levels of phosphate, hardness, and chlorides, it is not the mineral content that will be of greatest concern.

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 SiO2)	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

Biological Content - The greatest challenge of using recycled water will be overcoming the rich nutrient base. With the amount of detergents, food, and other contaminants suspended in the water, it is a rich source of culture growing media. The biological content of recycled water will be the greatest detriment to using recycled water. With all the processing, treatments, and procedures of the waste treatment facilities, there is significant biological contamination of the treated water. Every bacteria, algae, slime, virus, and other organisms known to man can be expected to be in the recycled water at some time or another.

In July of 2000, a man was swimming in the Gulf of Mexico and a cut on his leg became infected. After several days in the hospital, he died. The infection was from the biological contamination of the Gulf from a waste treatment facility. Oysters used to be the staple crop of Apalachicola FL, but today if you eat raw oysters, you are taking your life into your own hands. There have been numerous deaths and serious illnesses from eating oysters. This is why the fish near the shore have died, or have left. The animals that produce shells have either died or left the area for a safer living environment.

How will this affect irrigation? Expect to see large colonies of algae, slime, and bacteria growing in the systems. Chlorine will be ineffective to control these growths as the water is already chlorinated and it is unable to control or kill the large number of organisms in the water. Much of the chlorine will attach itself to the contaminants in the water and is not available for attacking the pathogenic organisms in the water.

System filters will begin collecting organic masses on the surface of the filter media and the pressure in these systems will increase. Back washing will begin to be required more often until the pressure is too great and the filter media will require cleaning or replacing. Automatic filters that back wash when the pressure differential gets to a certain point, will begin flushing frequently and eventually will be flushing as often as it is filtering, rendering the filter system useless. In working with highly contaminated water, there have been situations when using seep irrigation that a 2" PVC pipe has been plugged with organic matter. I would not have believed it if I didn't witness it myself.
As in most irrigation systems, the smaller the orifice, the more likely it is too plug. Drip tape and microjets will be the first to plug. Using well water or surface water, these micro irrigation systems can and do plug within as little time as a week or two. An entire field can plug within a month. With the drought conditions of recent years, these situations have become even more of a problem and growers are looking for answers to solve their water problems.

Even larger orifices such as bubblers and shrub misters will have severe problems with organic plugging. Usually larger orifices, such as those found in rotary and other larger volume pop up sprayers, don't have problems. However, the larger systems may also have problems over time when using recycled water. It will depend on the lay out of the system, frequency of water, temperature, and other factors.

One type of treatment that is effective in removing and preventing the formation of organic deposits that cause plugging are products such as Line Blaster. An organic composition formulated for specific use in removing these deposits. The oxidizer qualities in Line Blaster are able to overcome the rich nutrient base and to burn off the organics. Low dosages (50 to 100 ppm) and high concentration (over 75% active) make Line Blaster effective against high concentrations of organics**.** The salient

characteristic of these types of products is that they have the ability to penetrate into the biomass and break up the mass and remove the entire mass and prevent its regrowth. These products are a new technology developed to attack and control these biomasses. These products are the only type of product available that are able to handle these new water problems and are just beginning to reach the market across the US.