WASTEWATER FORESTS and a Carbon Sequestration Plan

by Daniel Wickham, Ph D. 1999, Edited and updated by Reinhold Ziegler 2006

Conventional wastewater treatment is based on a relatively simple premise: First, remove as much of the organic waste as possible through settling and filtration; second, convert the soluble organic matter into biological tissue that can be removed by physical means; and finally, destroy the rest through oxidation to carbon dioxide. While wastewater technology based on microbial treatment has done much to purify our waters, it has done so at a cost — in dollars and also in its effect on global atmospheric carbon balance.

In 1991, US water treatment systems collected some 35 billion gallons of wastewater each day, requiring some 72.8 million pounds of oxygen to oxidize the organic material in the wastewater. About one-third of the organic load goes to anaerobic digesters. Stabilizing the remaining soluble fraction in aeration basins takes about 48 million pounds of oxygen and some 26 million kilowatt hours (kwh) of electric power.

On average, 1.5 pounds of CO2 are produced for each kwh used. Just supplying the power to operate the aeration basins generates 19,500 tons of CO2 each day — 7,117,500 tons a year. Supplying the power to oxidize the sulfur and nitrogen in the wastewater, along with pumping and other costs, generates another 40,000 tons of CO2 per day - 14,600,000 tons per year. Ironically, the purpose of all this electricity is to create more CO2 through the oxidation of the organic carbon in the waste stream.

Virtually all of the 72 million pounds of oxygen eventually is converted to CO2 resulting in 97 million pounds of CO2. The aeration basins receive about two-thirds of that — 65 million pounds per day or 11,862,500 tons per year. Add that to the 14,600,000 tons released by the electricity and you have conventional aerobic treatment of domestic waste releasing over 26.5 million tons of CO2 into the atmosphere every year.

Adding in the industrial sewage treatment systems that oxidize the vast quantities of organic waste from food processing, pharmaceuticals, petroleum and such would conservatively raise the impact of conventional aerobic treatment to more than 50 million tons of CO2 per year (a huge amount but still only probably two or three percent of the total US releases).

A New Paradigm.

The premise behind conventional secondary treatment is the conversion of soluble organic matter to CO_2 and biological cells, which can be physically removed from the wastewater.   But who ever said bacteria were the only organisms capable of such a feat?

About 25 years ago a gentleman in Willits, California named Ed Burton developed a novel way to treat wastewater. Knowing that trees love wastewater, he proposed planting trees right over a leach device called the K-6 Ecochamber. Distribution pipes allow wastewater to pass through the system and be released directly to the tree's root zones. He installed a small forest at a wastewater treatment plant in Martinez, California in the late 1970s. This system still functions, providing unequivocal proof of the success of the technology. None of the units have ever clogged and the associated trees have shown spectacular growth rates. Redwoods planted with the units grew to 40 feet tall in as little as nine years. The wastewater at Martinez is treated, so the full advantage of using untreated effluent was never gained.

Burton grew trees with effluent coming directly from his home aerobic filter and digestion system with equal success. The fundamental treatment concept is identical to conventional secondary treatment: Conversion of soluble organic matter into cellular biomass. However, instead of growing a noxious, potentially pathogenic bacterial sludge that has to be disposed of at great expense, we obtain biomass in the form of valuable tree products. In areas without significant heavy metal content in their sewage, subsurface irrigated tree farms provide a constructive alternative to conventional treatment plants.

Forestry right now is still at the hunter- gatherer stage for most of the industry. While industrial tree farming exists, silviculturalists have never had access to unlimited supplies of nutrient-rich water for irrigation.

The Burton Plan.

The effluent from a typical 20 million gallon per day treatment plant serving about 100,000 people could be distributed to a plantation of redwoods of approximately 800 acres planted at 200 trees per acre. <u>The growth rate of redwood irrigated with this nutrient-rich water would result in a standing inventory of timber of about 8 billion board feet in 60 years, or about 133 million board feet per year.</u>

<u>At $1 per board foot for redwood, the city in question could earn an increase in asset value of its wastewater treatment system of $133 million dollars every year</u>. Conventional treatment plants simply depreciate in value. Concrete does not grow. A living treatment infrastructure such as a wastewater forest, however, increases in capacity and growth of the system is genetically pre-programmed.

One could grow 1,400,000 acres of trees in US wastewater plantations. Within 60 years, the amount of timber produced with such a system rises to the staggering quantity of 28 trillion board feet, or 460 billion board feet per year. <u>Each board foot contains about two</u>

pounds of cellulose which draws about three pounds of CO_2 from the atmosphere for its creation. These forests therefore would remove about 690 million tons of CO_2 from the atmosphere each year.

Add that to the 50 million tons that the now unneeded aeration basins no longer release into the atmosphere and you get a net reduction of 740 million tons of CO_2 per year - almost 15 percent of the total US release of CO_2 And trees will tie up the carbon for centuries or even millennia so the yearly savings can compound themselves. Once a wastewater forest is planted and grown for a time it will sustain itself even if you stop irrigating it. You can now move the wastewater to a new plantation and remove yet more CO_2.

New Hope for Mexico

The US has already built most of its infrastructure according to the old model. Mexico, however, like many developing countries has just begun building its wastewater treatment infrastructure. Over the next 50 years such countries will spend billions of dollars for the infrastructure to collect and treat their wastewater. Unlike the US they have the chance to do it correctly.

The 1997 conference on global warming in Kyoto introduced the concept of carbon dioxide credits. I like to imagine a “carbon dollar” that can be traded. But, as with paper dollars, a carbon dollar needs a bank to store it in. The wastewater plantation can be that bank. Mexico could invite the US — the worlds largest carbon dioxide emitter — to build its carbon dollar bank using Mexico’s wastewater. What better way to finance the creation of Mexico’s infrastructure?

The amount of credit for each tree could be worked on a sliding scale depending on the final use of the wood product. If left as forest habitat and unharvested the trees would get the maximum credit. If harvested for construction lumber, it would get the next level of credit because the wood will still tie up the carbon for many decades. Wood-based paper products, with a shorter cycle, would get a lesser credit.

Cut CO_2, Not Trees.

The US, which produces 25 percent of the world’s CO_2 could reduce its CO_2 emissions by 15 percent. Wastewater plantations on a worldwide basis have the potential to offset current CO_2 emissions entirely.

Beyond the CO_2 emissions or the profitability of such systems is an even more important consideration: the inherent ecological value of forests. A forest represents the most significant buffer that the earths surface can have. Western Australia cut its forests down years back and found that the soil water table moved to the surface. Without trees, the soil dried out and water began to evaporate from the surface. In the process, salt was left behind and the entire region was converted into a desolate salt desert.

The fact that such a simple change in waste-water treatment can compound in so many ways makes a strong argument for re-analyzing all our industries.

What is Next?

Ed Burton Company (EBC) has developed an integrated residential waste-treatment system where carbon dioxide is sequestered by redwood trees. After years of work this system is being scaled up for a municipal waste-treatment system for a typical small town of 10,000 people acompanied by about 40 acres of a redwood forest, fed underground, by the nutrient rich effluent.

We are now seeking carbon sequestration funds which will be used to build the carbon bank made of redwood trees. For further information about this process, the aquaculture and forestry technology and the resultant greenhouse gas sequestration, we suggest that you contact the following individuals.

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