EM Projects in USA

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Abstract
Currently the largest project with EM in the United States is the "Jefferson City Project", which is a comprehensive application of EM Wastewater Treatment Method to a large-scale municipal wastewater treatment plant. This demonstration project results from the coordination of a consortium of organizations, which have participated in some capacity in lending their resources for the successful completion of the project. These organizations include Sustainable Community Development (SCD), L.L.C. (Columbia, Missouri), the University of Missouri Department of Civil Engineering (Columbia, Missouri), the Effective Microorganisms Research Organization (Okinawa, Japan), Jefferson City Water Pollution Plant (Jefferson City, Missouri), and EM Technologies, Inc. (Tucson, Arizona). In an effort to engineer a more efficient method to reclaim the wastewater of Jefferson City the consortium aims to solve universal problems of odor and water quality by managing the microbial ecology of the wastewater and it's conduits (i.e. sewers and processing units) using EM technology. After collecting baseline (pre-EM) data for five months, EM applications were begun in august this year. Between 27 to 35 metric tons of EM are applied to the wastewater treatment system each week. EM is produced using a "Mobile Production Unit" (MPU) that was designed and built by Dr. Teruo Higa, EM Research Organization and Sustainable Community Development. The MPU is inside a large truck, so EM can be delivered in large quantities anywhere it is needed. EM is successfully helping to reduce foul odors, decrease sludge and improve effluent water quality at the Jefferson City Project.

Keywords: EM, wastewater, treatment, odor, sludge, water quality

Introduction

EM technology is spreading to large-scale projects in environmental, agricultural, livestock and human health areas. Several universities, government agencies, private companies, volunteer organizations and individuals work cooperatively to implement EM strategies. EM technology is steadily growing in the United States, which means progress is being made for a better world.

Even though the USA population is only about 7% of the world population, it consumes approximately 50% of the world's resources and produces 50% of the world's waste. This is an unfortunate fact. This fact also has its consequences. As a result of the waste, the USA population has one of the highest cancer rates of any country in the world.

What a paradox, to be one of the world's richest and most powerful and yet one of the world's sickest.

The longest river in North America is the Missouri River. It stretches across many states, collecting all of the runoff from farms, livestock operations and cities. Unfortunately, the Missouri River is very polluted because of this runoff. Therefore, we have started a small, but growing, effort to clean up the Missouri River, which is like the life-blood of the people. It is quite beautiful, yet people often get skin allergies from swimming in this water and many of the fish can not be eaten because of high levels of heavy metals from city and industry wastewater and agricultural chemicals like "chlordane" in the fish. It is understood by the scientific community that there are four main sources of pollution to the Missouri River. 1) agricultural runoff from fertilizers and pesticides. 2) runoff from large scale confined livestock operations. 3) runoff from cities and poorly treated wastewater from cities. 4) industrial pollution from factories that discharge poorly treated water.

Jefferson City is the capitol city of the State of Missouri. The Wastewater Treatment facility for the city is located across the Missouri River from the capitol building. Jefferson City has a population of 43,000 people and produces approximately 10 million gallons (35 million tons) of wastewater each day. The Wastewater treatment facility was built 35 years ago. The city has doubled its population in 35years. So, there is too much wastewater for the treatment facility to clean it very well before the water is discharged into the Missouri River. Thus, the city adds to the pollution of the Missouri River. Also, this causes a bad odor, so when the wind blows a certain direction on a hot day, the capitol building does not smell so good.

Because of this, SCD organized a team to create a research and demonstration project with EM technology to solve the odor and pollution problem of Jefferson City Wastewater Treatment Facility. The type of wastewater treatment method used at the facility is known as the "trickling filter" method. The wastewater is pumped up to the top of the buildings and then trickles down through a medium where oxygen and microorganisms can clean the water.

In an effort to engineer a more efficient method to reclaim the wastewater of Jefferson City the consortium aims to solve universal problems of odor and water quality by managing the microbial ecology of the wastewater and it's conduits (i.e. sewers and processing units) using EM technology. Goals of the project are:

I. Odor treatment (compared to Bioxide, a nitrate salt) at sewers and at treatment plant
II. Sludge reduction and treatment,
III. Water quality improvement (BOD & SS reduction)
IV. Pathogen removal (fecal coliforms)
V. Tertiary treatment (Nitrogen and Phosphorus reduction)

Materials and Methods

After collecting baseline (pre-EM) data for five months, EM applications were begun in august 2001. Between 27 to 35 metric tons of EM are applied to the wastewater treatment system each week. EM-Extended is produced by SCD staff and delivered to five points around the city where it is injected into the sewer lines on a continual basis (See Table 1).

Table 1. Amount of EM-Extended Applied to Jefferson City Wastewater Facility August – November 2001

WEEK	**AMOUNT OF EM APPLIED (GALLONS)**	**AMOUNT OF EM APPLIED (METRIC TONS)**
August 6-12	6,950	26.3
August 13-19	6,900	26.1
August 20-26	4,210	15.9
August 27-September 2	9,775	37.0
September 3-9	6,970	26.4
September 10-16	6,675	25.3
September 17-23	6,675	25.3
September 24-30	6,885	26.1
October 1-7	6,860	26.0
October 8-14	6,860	26.0
October 15-21	7,095	26.8
October 22-28	7,050	26.7
October 29-November 4	8,350	31.6
WEEKLY AVERAGE	7,019	26.6

EM is produced using a “Mobile Production Unit” (MPU) that was designed and built by Dr. Teruo Higa, EM Research Organization and Sustainable Community Develepment. The MPU is inside a large truck, so EM can be delivered in large quantities anywhere it is needed. Dr. Higa named this production facility the “EM EXPRESS”. The MPU was designed and constructed to produce the 20,000 gallons, 60 tons, of high quality EM-Extended regardless of weather conditions or outside temperatures. In Missouri the seasonal temperatures can vary from the high 90’s F, near 37 C, to lows of around 0 F, -17 C. The goal was to build a sheltered production system that would require the minimal weekly labor without the additional budget cost of automated systems. The final system design consists of many manually operated values and pumps. The efficiency of the MPU has greatly reduced past production labor requirements. The MPU was constructed inside an older recycled 48-foot, 14.6 meter, insulated semi trailer at the SCD shop in Columbia. The system inside the MPU consists of a combination of seven 2-ton tanks, one 6-ton tank, one 1-ton tank for molasses, a mixing tank and a sink. All tanks are connected by pipes, valves and pumps, which are controlled from a control station. The tanks are secured to platforms that permit the bottom drainage necessary for tank cleaning. Water and molasses for producing EM is heated to high temperatures using these in-line water heaters. With high temperatures and high quality production materials, EM matures to a pH of 3.4 within 48 hours. The room is kept warm, about 35C, by the heat given off from the hot water. The water used for producing EM is

purified and structured by passing through a pi water filter, which uses EM-X ceramics. This water treatment helps to produce high quality EM in a short time. The matured EM is pumped out of the MPU to tanks on trucks and trailers for delivery to the inoculation site. The EM is delivered weekly to different inoculation points where a tank is kept that has a drip system to slowly and regularly inject EM. It gets very cold in Missouri in the winter, so SCD staff built insulated houses to hold the EM inoculation tanks throughout the city.

Water analyses includes pH, temperature, humidity, oxidation/reduction potential, sulfide (S^{2-}) and sulfate (SO_4^{2-}). Air analyses involve two separate metering systems to measure hydrogen sulfide (H_2S) at the collection and a Scentometer was used to measure trickling filter odor at the treatment plant.

Because of limited space, results of EM effects on sludge, odor and chemical usage is presented.

Results and Discussion

After applying EM for about one month, there were indications that beneficial microorganisms were beginning to populate the system. A reddish brown color developed on some of the treatment equipment. This did not exist before EM application. The color is colonies of photosynthetic bacteria, lactic acid bacteria, algae and yeast. Before EM application, the water was not clear enough to see the bottom of the clarifiers. However, during EM application, the water is clear enough to see the bottom and during EM application, there is a reddish-brown color on the filter now. The filter looks cleaner and does not have a strong odor. Before EM the filter was totally black and had a very bad odor. During EM application there is the red color and the water is clearer. Without EM, no red color and too much foam and black water to see the bottom.

The results are preliminary because the project has just begun, However already results can be seen in October, 2001. Figure 1 is a comparison of October 1999, 2000, and 2001. October 1999 and 2000 are without EM. 2001 is with EM. The red line on this graph is the amount of wastewater going into the treatment facility. The yellow bar is the amount of sludge produced at the facility. It can be seen that in 1999 and 2000, the amount of sludge and amount of wastewater are closely correlated. However, since using EM, the amount of sludge has been reduced, even though the amount of wastewater has increased. This is a big benefit to the city because the sludge is very toxic and therefore very expensive to dispose of.

Figure 1.
October Sludge Disposal Relative to Plant Influent

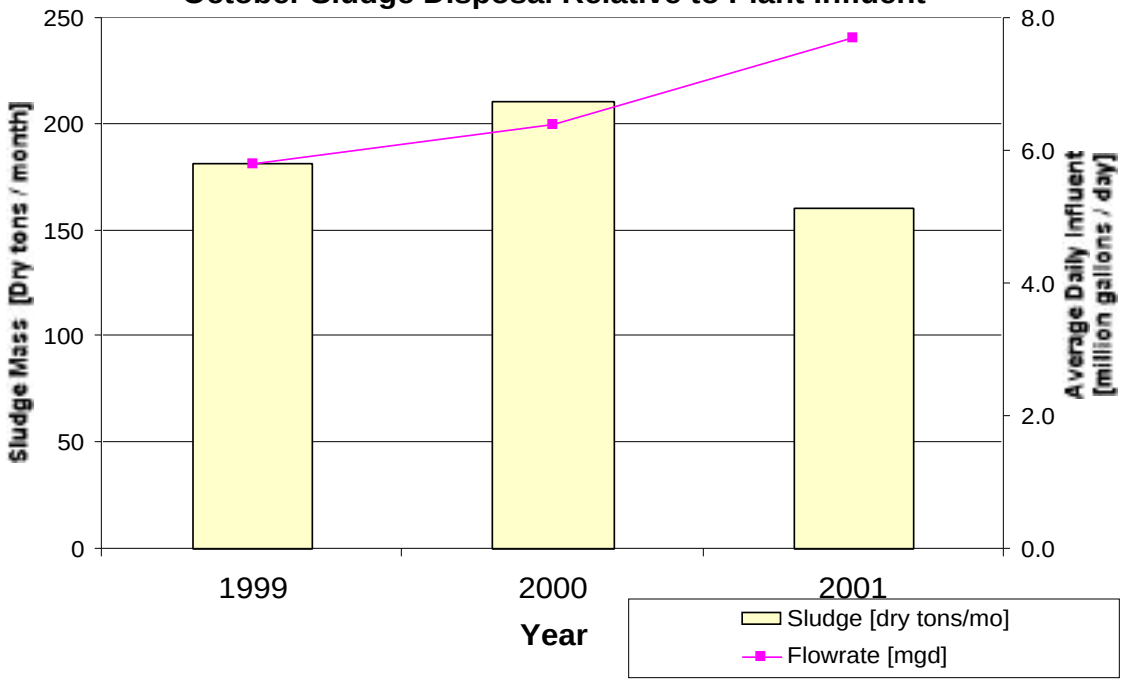
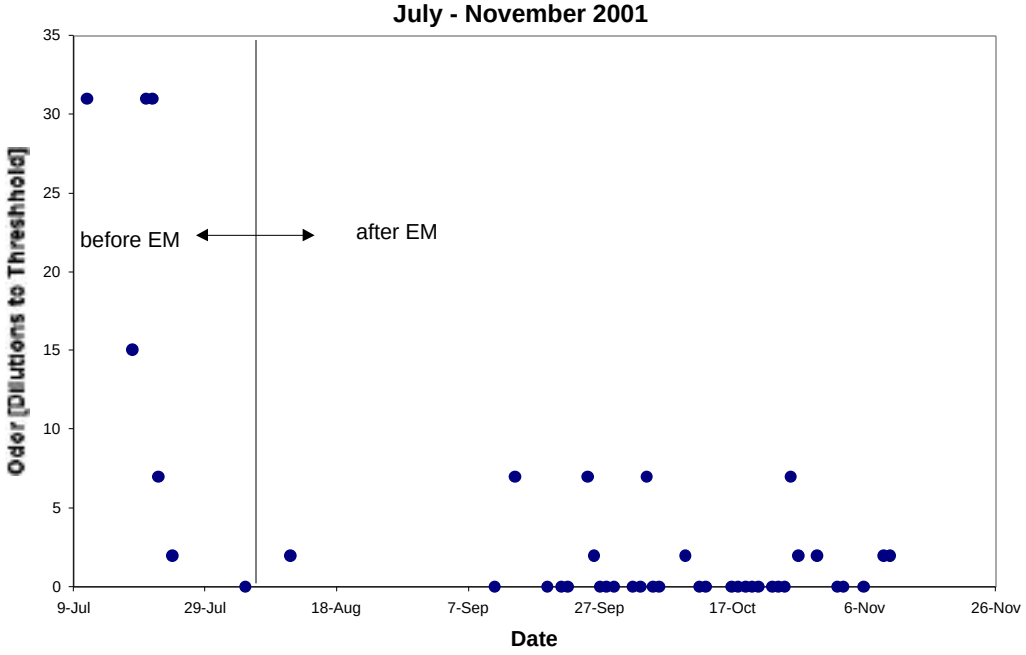


Figure 2 shows data from odor samples. The line in the middle separates before EM and after EM. You can see that there are several high odor points before EM, but with EM, there are no high odor points.

Figure 2. Scentometer Readings
July - November 2001



The wastewater treatment facility uses many chemicals, especially for odor control. These chemicals are very expensive and very toxic. Table 2 shows that in 2001 the amount of chemicals needed when applying EM is significantly reduced.

Table 2. Chemicals Used at Jefferson City Wastewater Treatment Facility During September and October 1999, 2000 and 2001

CHEMICAL	**September 1999**	**September 2000**	**September 2001 (EM)**
Lime – Quicklime	30 tons	47 tons	37 tons
Ferrous - Odor Control	3800 gallons	2070 gallons	25 gallons
Bioxide – Odor Control	3500 gallons	1263 gallons	400 gallons
Polymer – Dry	825 pounds	900 pounds	600
CHEMICAL	**October 1999**	**October 2000**	**October 2001 (EM)**
Lime – Quicklime	36.95 tons	53.52 tons	0 tons
Ferrous – Odor Control	2540 gallons	2830 gallons	800 gallons
Bioxide – Odor Control	1544 gallons	1600 gallons	840 gallons
Polymer – Dry	530 pounds	750 pounds	650 pounds

Based on the preliminary data, it is concluded that EM is successfully helping to reduce foul odors, decrease sludge and improve effluent water quality at the Jeferson City Project.