# EM EFFECT TO REDUCE SLUDGE IN WASTE WATER TREATMENT

Reported by Hiroyuki Arichi,
Chief of Operation Adjustment Tsuruoka City Waste Treatment Center of Tsuruoka City Construction Department

**About the reporter:**
Born in Tsuruoka City of Yamagata prefecture in 1960. Worked for Tsuruoka City Waste Treatment Center since 1993 with successful results in improving waste water system, in reviewing sludge treatment system to improve and expand the system. Published in professional journals; “Experimental Devise to isolate Mercury Amalgam by Centrifuge”, “Status of Compost Use in Tsuruoka City”, “Effect of Inorganic Chloride in Compost Fermentation Process”.

**Summary**
Sludge from waste water system has become a big problem all over Japan due to the difficulty of obtaining appropriate dumping ground. In Tsuruoka City, all sludge from waste water systems are composted. However, the amount of sludge has been increasing to near the limit of its capacity to compost. Therefore, ways to reduce the amount of sludge have been looked into as an alternative, and EM was experimentally applied to oxidation ditch to test its effectiveness to suppress the amount of sludge.

The experiment was conducted at one of the City’s small waste water treatment centers, Yunohama Treatment Center. The Center started its operation in 1992 as an oxidation ditch method treatment facility to preserve quality water for Yunohama hot spring resort area. The planned capacity of the facility is 3,000 $m^3$/day, and the actual volume during the experiment was approximately 1,000 $m^3$/day.

During the experiment of EM application, scum generation was suppressed, and ideal operating condition was maintained. The primary and the secondary effects of EM application and reduction of sludge were remarkable. It was also effective in saving some costs. The report explains details of one year experiment.

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### INTRODUCTION

Sludge from waste water treatment has become a big problem because of the difficulty of securing appropriate dumping sites.

In Tsuruoka city, all sludge from waste water system has teen composted and returned to soil. However, the amount of sludge has been increasing to the limit of the city's capacity to compost. Therefore, effective ways to reduce the amount of sludge have been looked into. As one of the alternatives, EM application was experimented for about one year to an oxidation ditch method treatment facility. I like to report the result of the experiment.

### EXPERIMENTAL SITE

The experiment to apply EM was conducted in one of the city's small water treatment facilities, Yunohama treatment center. The center started its operation in 1992 as an oxidation ditch method treatment facility to preserve quality water for Yunohama hot spring resort area. The planned capacity of the facility is 3,000 cubic meters (per day), and the actual volume treated during the experiment was approximately 1,000 cubic meters.

### EXPERIMENT

**1) Extending EM**

Ten litters of EM-1 and 7 litters of molasses were mixed with the after-treatment water to make a total mixture of a half or one cubic meter, and the mixture was left at the temperature of 35 Celsius for one week. During the extension, lactic acid bacteria multiply first and lower acid (pH) level. The extension is considered completed when acid level comes down to around 3.5 pH, and the color turns reddish brown from dark brown.

**2) How to apply EM**

One cubic meter of the extended EM was added to a sedimentation pond once a week. It was suggested that adding EM by several drops at a time for a prolonged period of time is preferable. However, the experimental site is located far from the city and not easy to reach, the total required amount was added at one time. The amount added was approximately 140 parts per million (ppm).

**3) Experimental Period**

The experimental period was set for one year from June 1996 through May 1997, and the period from June 1995 through May 1996 was selected as the control period.

## RESULTS

### 1) Estimated Amount of Solid Substances

Based on the experimental results, the amount of solid substances per month and per day were estimated. Taking into consideration of changes in surplus sludge due to fluctuation of MLSS (mixed liquid suspended solid) density, the amount of solid substances was calculated as follows:

DS = DS1 + (DS3 - DS2)

Whereas: DS = amount of average solid substances per day (kg)

DS1 = amount of average solid substances per day (kg)

DS = DS1 + (DS3 - DS2)

Whereas: DS = amount of average solid substances per day (kg)

DS1 = amount of average solid substances per day (kg)

DS2 = amount of solid substances in a response tank in the current month divided by the number of days (kg)

DS3 = amount of solid substances in a response tank in the following month divided by the number of days (kg)

### 2) Estimate of Theoretical Volume of Solid Substances

A ratio of solid substances (DS) in relation to the amount of removed solid substances (SS) in the control period was calculated, and the ratio was applied to the amount of removed solid substances (SS1) in the experimental period to estimate a theoretical amount of solid substances in the following formula:

DSx = (DS/SS) * SS1

Whereas: DSx = Theoretical amount of solid substances (kg)

DS = Accumulated amount of solid substances per day in the control period (kg)

SS = Removed amount of solid substances per day in the control period (kg)

SS1 = Removed amount of solid substance per day in the experimental period (kg)

### 3) Comparison

Actual amount of solid substances and theoretical amount of solid substances were compared in Chart-1 and Graph-1. Provided that the other conditions are equal. EM application reduced the amount of solid substances by 32.5%.

### 4) Sludge Retention Time (SRT)

Average SRT during the experimental period was 50.8 days and 25.6 days during the control period. Therefore, the amount of solid substances must be evaluated in relation to (biochemical) respiration of activated sludge due to increased SRT. A comparison of SRT during the control period and the experimental period is shown in Graph-2.

**5) Reduction of Solid Substances due to (Biochemical) Respiration**

The Graph-3 shows the solid substances in the control period: X axis represents SRT, and Y axis represents the amount of solid substances.

Y = 137 - 1.19X

**6) A correction to Estimated Amount of Solid Substances**

As shown in the previous formula, the amount of solid substances reduced by 1.19 kg per one SRT day. Therefore, EM application reduced solid substances by 16.4% when biochemical respiration of the activated sludge is taken into consideration.

**7) Comparison**

The actual amount of solid substances was compared to the corrected theoretical amount of solid substances in Chart-2 and Graph-4. When reduction due to biochemical respiration of the activated sludge because of SRT increase. EM application reduced the solid substances by approximately 16.4%.

**EVALUATION OF EM APPLICATION**

**1) Evaluation Specific to the Yunohama Treatment Center**

Yunohama center had been forced to operate with short SRT in order to suppress scum which was constantly generated by actinomycetes since its opening in 1992. AS a result. biochemical respiration of the activated sludge was suppressed, and relatively large amount of sludge accumulated for an oxidation ditch method facility.

However, during EM application, scum generation was suppressed. Therefore, it was made possible to set sludge retention time (SRT) closer to the standard value for an oxidation ditch method and consequently to activate biochemical respiration of the activated sludge. This resulted in reduction of solid substances by 32.5%.

The accumulated sludge is removed and transferred to a sludge treatment center in the city. The cost incurred to remove and transfer accumulated sludge was reduced to 92%, while the amount of waste water treated during the experimental period increased to 123%. This is translated to the savings of approximately 2 million yen per year.

The cost for EM is approximately one million yen per year. Therefore, EM application is economical. There are other chemicals available to suppress scum, but they are expensive and not economical.

**2) General Evaluation**

In the treatment facilities where increase in sludge retention time (SRT) is not needed, cost savings must be examined closely before determining EM application. The cost of EM and man power required to extend EM against savings from reduction of cost due to reduced accumulated sludge. In most treatment facilities, however, 16.4% savings are significant and economical.

## CONCLUSION

I heard that there is a treatment method called JALUS-III. I understand that, in this method, advantages of faster reaction of aerobic treatment and sludge reduction effect of anaerobic method are combined to compliment each other.

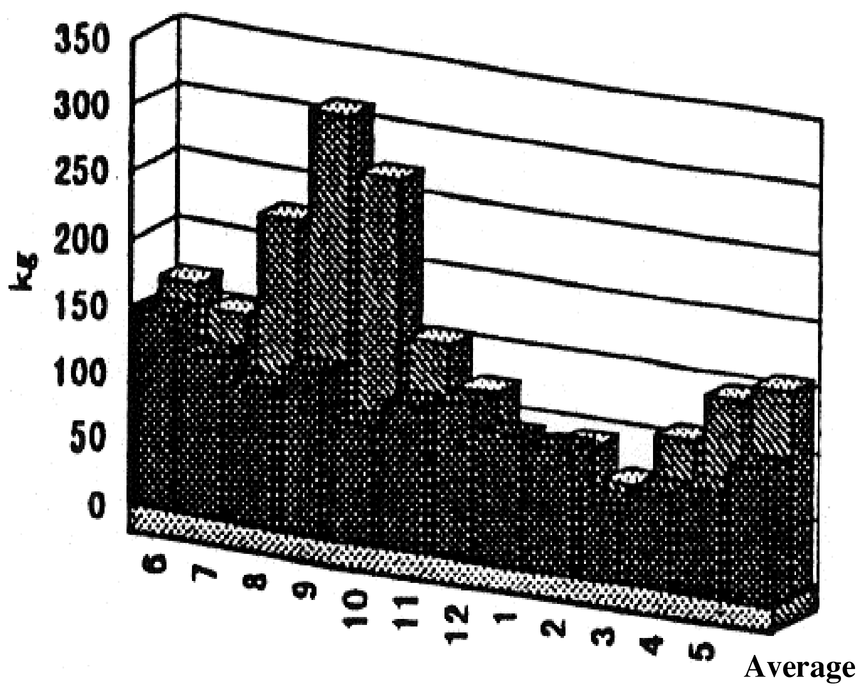
EM application, I think, facilitates effect of different microorganisms and reduces accumulated sludge as a result. However, it is not commonly practiced yet, and no standard manual was available to guide our experiment.

In Tsuruoka city, we plan to continue the experiment of EM application, and we like to have opportunities to share experiences that other treatment facilities have had with EM application.

Technical cooperation provided by: Mr. Yoshikazu Shinkawa, Section Chief of EM Laboratory of International Nature Farming Research Center
Mr. Shigeomi Asai, Researcher of EM World

Solid Substances

| Date | Actual volume | Theoretical volume |
|---|---|---|
| June 1996 | 150.2 | 163.7 |
| July | 123.4 | 146.5 |
| August | 107.3 | 223.8 |
| September | 125.1 | 306.3 |
| October | 90.5 | 267.1 |
| November | 112 | 151 |
| December | 119.4 | 119.9 |
| January 1997 | 100.2 | 81.9 |
| February | 96.5 | 90.1 |
| March | 62.5 | 68.2 |
| April | 77.9 | 107.2 |
| May | 85.2 | 143.1 |
| Average | 105.9 | 155.733 |



Solid Substances

| Date | Actual volume | Corrected theoretical volume |
|---|---|---|
| June 1996 | 150.2 | 143.1 |
| July | 123.4 | 130.7 |
| August | 107.3 | 168.2 |
| September | 125.1 | 216.6 |
| October | 90.5 | 198.9 |
| November | 112 | 113 |
| December | 119.4 | 114.9 |
| January 1997 | 100.2 | 84.8 |
| February | 96.5 | 94.7 |
| March | 62.5 | 54.9 |
| April | 77.9 | 73.3 |
| May | 85.2 | 116.4 |
| Average | 105.9 | 125.792 |