

Utilization of EM Technology for Overcoming some Environmental Problems in Vietnam

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***Abstract :** Environmental protection for a sustainable development represents a vital issue of every country in the world. Vietnam is developing its economy, focusing on a high-speed industrialization, especially in industry, agriculture, services and urbanization. The higher growth of economy the more problems to be solved in environmental protection, especially the quantity of wastes discharged from production and people's life is increasingly growing, aggravating pollution and putting a stronger pressure on environment and ecology. Wastes include solid, liquid and gaseous ones. Seeking appropriate technologies for treating wastes and protecting environment is a urgent task in Vietnam at present. Since April 1997, EM technology has been applied in different domains: cropping, animal husbandry, environment treatment such as for treating dumps, processing garbage into fertilizers, treating the liquids secreted from garbage, treating the waste water discharged from urban areas in over 60% of cities and provinces of the country. Some study results have been presented in this report to show that EM technology applied in environmental treatment in Vietnam is very effective; EM technology has been proved to be safe, low-cost, effective and easy utilization in environmental protection.*

Introduction

During the process of industrialization and modernization for economic development, environmental protection constitutes a urgent problem in Vietnam. The increasing speed of urbanization, together with the speed of industrial development in urban areas and agricultural development in rural areas, have brought a strong pressure on environment. The annual demographic growth in urban areas averages 4.2%, i.e. the absolute growth is 0.5 million people per year. At present, Vietnam has 632 cities and towns with a population of 19 million, or 23% of the country's total population. Over 70% of cities, towns and population are concentrated in the deltas and coastal areas. The areas of cities and towns occupies about 0.35% of the country's total area (2000 figure). Untreated waste, especially organic waste, represent a source of serious pollution. The waste are garbage, rubbish discharged from urban areas and waste materials discharged from agricultural production, from animal husbandry stations, from processing factories. For instance, the average daily quantity of solid waste discharge from people in urban areas is about 0.5-0.6 kg per capita; the figure in Hanoi and Ho Chi Minh city is 0.8-1.0kg; and of which the proportion of organic waste is 40-60%. At present, in Vietnam 95% of solid wastes discharged from people are treated by burying; only about 5% are treated into compost.

Waste water from living quarters, rain water and industrial waste water converge on the systems of sewerage; and almost all these sources of waste water are not treated and form a considerable polluting agent.

According to forecast, until 2010, the population of urban areas will rise to 30.4 million, or 33% of the country's total population, the quantity of solid wastes and waste water discharged from people's life will increase by 2 to 2.2 times and 2 to 2.5 times respectively. So, the treatment of waste matter discharged from people will become a big problem in the future.

Studies have been conducted on the utilization of EM technology for treating solid and liquid waste in Vietnam.

Materials and Methods

Materials

Secondary EM solution is produced from 1 liter of EM1+3kg of molasses + 96 litre of water. EM Bokashi is produced as follows:

- For treating garbage: rice bran and sawdust (1:1) fermented by EM solution
- For treating water of shrimp raising ponds: poultry excrements and rice bran (1:2) fermented by EM solution
- Garbage and wastes of urban areas with 50% of organic matters in Tay Mo dump (Hanoi city); quantity: 1,000tons/day. Thac Gian lake with an area of 3ha and a depth of 1.5-2m.

Methodology

Environmental indexes are measured and identified;

Comparison method is applied;

Technological procedure is identified for giving guidance to practices.

Treatment of garbage and wastes of urban areas to be buried

Technological procedure of burying garbage:

Garbage and wastes are levelled, and pressed by caterpillar bulldozer until the bulk density is 550-700kg/m³; EM solution is sprayed on garbage and waste (EM1 is produced into secondary EM solution. It depends on the weather and the moisture of garbage; secondary EM solution is diluted at the rate of 1/50, 1/100, 1/200 and 1/500 to be sprayed on garbage and waste).

A layer of EM Bokashi is sprinkled on every layer of garbage and waste of 0.1-1.0m thickness, at the rate of 0.1-0.2kg/m², then the layer of EM Bokashi is covered by a 10cm thick layer of soil.

Powdered lime and chemical antiseptics are not used in the treatment

The dump is located in Tay Mo, Hanoi city.

Discussion

Since 1997 until now, EM technology has been studied and applied in treating buried garbage and waste, processing waste into compost, treating the liquid waste oozed from garbage, treating waste water discharged from urban areas (water ponds). Some results have been obtained as follows:

Soild Waste

Aerial indexes in untreated and treated areas of Tay Mo dump show the efficiency of EM technology.

Table 1. Analysis of Garbage at Tay Mo dump (February 1998)

| Date of Measurement | Site of Measurement | Lot No. | CO ₂ (mg/m ³) | SO ₂ (mg/m ³) | H ₂ S (mg/m ³) | Suspended dust TSP (mg/m ³) | CH ₄ (mg/l) |
|--------------------------------------|--|---------------|--------------------------------------|--------------------------------------|---------------------------------------|---|------------------------|
| 18/2/98 | Fresh garbage not yet treated with EM | 1 | 2.440 | 0.2824 | 0.2772 | 2.886 | Not detected |
| | | 2 | 2.397 | 0.2105 | 0.757 | 2.652 | - |
| | | 3 | 2.838 | 0.2176 | 0.824 | 2.230 | - |
| | | 4 | 2.120 | 0.2090 | 0.880 | 1.850 | - |
| | | 5 | 2.956 | 0.1988 | 0.536 | 1.206 | - |
| | Average | 2.550 | 0.2360 | 0.754 | 2.166 | Not detected | |
| 18/2/98 | Garbage treated with EM | 1 | 1.137 | 0.0132 | Not detected | 0.192 | - |
| | | 2 | 1.040 | 0.0146 | - | 0.192 | - |
| | | 3 | 1.496 | 0.0120 | - | 0.190 | - |
| | | 4 | 1.180 | 0.0120 | - | 0.194 | - |
| | | 5 | 1.328 | 0.0440 | - | 0.192 | - |
| | Average | 1.236 | 0.0192 | - | 0.192 | - | |
| Vietnam Standards 5937 and 5938-1995 | Tolerable concentration in living quarters(mg/m ³) | | | | | | |
| | - Maximum in each time | Not regulated | 0.5 | 0.008 | 0.3 | | |
| | - Average day and night | | 0.3 | 0.008 | 0.2 | | |
| Environment Standards of MOSTE 1993 | Tolerable concentration in production areas (mg/m ³) | | 1% | 20 | 10 | 76 | |

Source: Report "Environmental impact evaluation in Tay Mo dump, Hanoi city, March 1998"

Observations:

- Table 1 shows that bad smelling and toxic gas exhaled from treated garbage and wastes is obviously reduced compared with untreated ones and meets environmental standards TCVN No 5937 and 5938, 1995.
- Economic efficiency: The EM treatment can save 3,150 VND for one ton of garbage and wastes compared with the treatment with powdered lime and antiseptics.
- The population of flies reduced by 80-90% compared with untreated areas.
- Until now, this technology has been applied in about 62% of cities and provinces in Vietnam. (Approved by Decision No. 2058/QD-UB dated 23/5/1998 of Hanoi City Peoples' Committee)

Treatment of liquid secreted from dumps

The liquid secreted from dumps is characterized by a high concentration of organic matter (COD 3.000-60.000mg/l; BOD 2.000-30.000mg/l), a high concentration of suspended solid (SS) and soluble organic matter, a high concentration of toxic matter and a high density of pathogens. This liquid can pollute water, soil and air, especially underground water. This is the biggest difficulty to be solved in dumps in Vietnam.

During treatment, EM effects have been studied:

- Reduction of fetidness of the liquid secreted from dumps.
- Reduction of pollution indexes of the liquid secreted from dumps, and the components of the liquid are allowable to be discharged into water, soil and air in comparison with Vietnam's environmental standards.

Method: The secondary EM solution is directly poured into the basin of liquid secreted from the dump at the proportion of 1/1000 to restrict fetidness, then EM is added to the systems of waste collection tank and liquid treatment as shown in the following diagram:

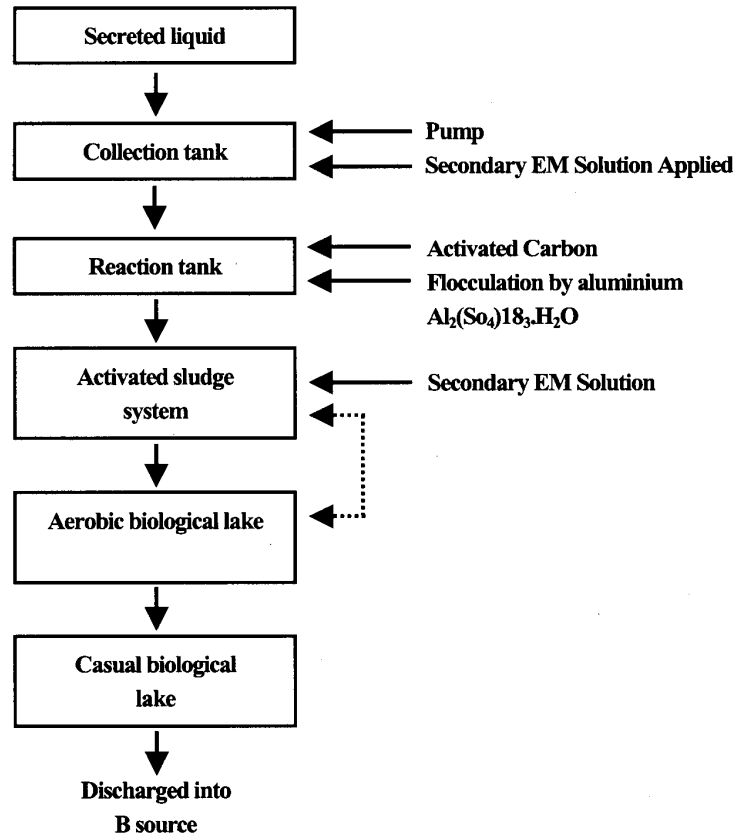


Figure 1. Treatment of Liquid Secreted from Garbage and Wastes

**Liquid waste:* After treatment of the liquid in the collection tank by EM, the liquid secreted from the dump reaches the indexes as shown in Table 2.

Table 2. Results of Analysis of Liquid Waste from Garbage in the Collection Tank

| No | Indexes | Unit | Liquid Waste Before the Treatment by EM 1/10/1999 | Liquid Waste after the Treatment by EM | | TCVN 5845-1995 |
|----|------------------|-----------|---|--|---------------------|-------------------|
| | | | | 15/11/1999 | 22/2/2000 | |
| 01 | pH | mg/l | 7.2 | 8.6 | 8.65 | 5.5-9 |
| 02 | COD | mg/l | 17,600 | 3,000 | 1,060 | 100 |
| 03 | BOD5 | mg/l | 9,000 | 2,250 | 750 | 50 |
| 04 | Total Nitrogen | mg/l | 1453.5 | 876 | 771 | |
| 05 | Total Phosphorus | mg/l | 27.2 | 7.2 | 10 | 6 |
| 06 | SS | mg/l | 3,070 | 107.1 | 897 | 100 |
| 07 | Chromium | mg/l | 0.001 | <0.001 | - | 1.0 |
| 08 | Mercury | mg/l | <0.001 | <0.001 | - | 0.005 |
| 09 | Arsenic | mg/l | <0.01 | <0.01 | - | 0.1 |
| 10 | Lead | mg/l | 0.034 | 0.011 | - | 0.5 |
| 11 | Cadmium | mg/l | 0.015 | 0.0012 | - | 0.011 |
| 12 | Total Coliform | MPN/100ml | 7.73x10 ⁵ | 1.89x10 ⁵ | 160x10 ³ | 1.10 ⁴ |

Then, the liquid is conducted to the system of treatment by activated sludge with and without EM addition. The concentration of pollutants is show in Table 3.

Table 3. Comparison of Concentration of Pollutants before and after Treatment by Activated Sludge System, with and without EM Addition

| No | Index | Unit | Before Treatment by System | After Treatment by System without EM Addition | After Treatment by System with EM Addition | Increasing of Treatment Level (time) | TCVN 5945-1995 Column B |
|----|------------------|-----------|----------------------------|---|--|--------------------------------------|-------------------------|
| 01 | pH | | 8.55 | 8.3 | 7.7 | | 5.5-9.0 |
| 02 | COD | mg/l | 1,060 | 176 | 90 | 1.6 | 100 |
| 03 | BOD5 | mg/l | 750 | 89 | 50 | 1.1 | 50 |
| 04 | Total Nitrogen | mg/l | 771 | 100 | 24 | | 60 |
| 05 | Total Phosphorus | mg/l | 10 | 4.6 | 0.96 | | 6 |
| 06 | Suspended Solid | mg/l | 897 | 51 | 16 | 1.7 | 100 |
| 07 | Total Coliform | MPN/100ml | 1.6x10 ⁵ | 66 | 66 | 2.5 | 10 ⁴ |

Source: Application of EM in the Treatment of Garbage and Wastes Discharged from Urban Areas-The National Study Thesis, 1998-2000- Vina-Nichi Center for Technology Development, Ministry of Science, Technology and Environment (MOSTE).

Observations

- The application of EM in liquid secreted from the dump may accelerate the biological process, reduce the concentration of pollutants available in the liquid, reduce the fetidness, create conditions favorable for the following treatment process and increase the treatment effectiveness.
- The addition of EM solution while the treatment of discharged liquid with activated sludge may increase the treatment effect and reduce expense for the treatment.

Treatment of wastes water discharged from urban areas by EM:

The Thac Gian lake, with an area of 3ha and a depth of 1.5-2m, is situated in the center of Da Nang city. The lake functions as a regulator of water conservation and drainage and as a casual aerobic biological lake; but waste water discharged from people and from production is not treated and directly and excessively pours into the lake. The lake is polluted; its water is black and fetid. It has two inlet gates and one exit gate.

- Treatment time: From 1/4/1999 to 30/7/1999
- Secondary EM solution was applied in to the lake at the rate of 50ml/m³ of waste water.
- Treatment frequency: 2 times per month, during 4 months.
- Constant quantity of waste water in the lake: 36,000m³
- In June and July, EM secondary solution is added in drops at the 2 inlet gates, with a total of 3,000l.

Results

Lake water

The analysis of water components at the inlet gates and outlet gate is shown Table 4.

Table 4. Analysis of Components of Inlet and Outlet Water

| No | Indexes | Before Treatment by EM | | After Treatment by EM | | | | | | TCVN 5945-1995 Column B |
|----|------------------|------------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------------|
| | | 1/4/1999 | | 28/4/1999 | | 30/6/1999 | | 30/7/1999 | | |
| | | Inlet | Outlet | Inlet | Outlet | Inlet | Outlet | Inlet | Outlet | |
| 01 | pH | 7.32 | 9.19 | 7.28 | 7.78 | 7.14 | 8.5 | 9.19 | 8.25 | 5.5-9.0 |
| 02 | BOD5 | 148.0 | 38.0 | 85.0 | 25.0 | 113 | 40.0 | 120 | 25.0 | <50 |
| 03 | COD | 145.0 | 70.0 | 125 | 60 | 205 | 55 | 215 | 50 | 100 |
| 04 | DO | 0.02 | 15.7 | 0.12 | 4.97 | 0.06 | 8.27 | 0.04 | 8.23 | |
| 05 | Total Nitrogen | 53.74 | 24.72 | 50.69 | 32.81 | 37.99 | 27.44 | 37.98 | 23.32 | 60 |
| 06 | Total Phosphorus | 5.06 | 2.29 | 1.64 | 1.35 | 4.22 | 3.92 | 4.95 | 3.54 | 6 |
| 07 | Total Coliform | 54x10 ⁹ | 3.5x10 ⁴ | 1.1x10 ⁶ | 1.1x10 ⁴ | 24x10 ¹¹ | 1.6x10 ⁶ | 2.2x10 ⁶ | 0.7x10 ⁴ | 1x10 ⁴ |

Source: Testing of EM application for eliminating fetidness in Khanh Son dump and Thac Giam lake-Da Nang Urban Environment Company-December 1999.

Observations

- After 3 hours of treatment, the fetidness of lake water has reduced by 60%.
- The lake water pH' is stabilized within tolerance of Vietnam's environment standards (TCVN).
- Under the effect of EM, waste water discharged from urban areas into the lake has been treated; therefore outlet water can meet the standards of TCVN, thus ensuring environmental indexes, raising the regulation and treatment capability of lake, improving the environment living conditions for surrounding inhabitants and aquatics living in the lake.
- The treatment is simple, easy and low-cost.

Conclusions

From the reality of application of EM technology in Vietnam for treating garbage and wastes in dumps, processing wastes into organic fertilizer and treating water with high concentration of organic matters, the following conclusions may be drawn:

- EM technology is very effective in the management of environment in dumps, the treatment of solid wastes and the increase of capability of the systems of treatment of liquid wastes.
- EM technology may be used for treating waste water discharged from urban areas, treating the lakes for containing waste water, regulating micro climatic conditions, ensuring environmental indexes of water and air around the lakes, especially reducing pollution of underground water source;
- EM technology is simple for easy application and is low cost.

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