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Evaluation of Effective Microorganism (EM) for treatment of domestic sewage

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Abstract

Effective Microorganisms (EM), a culture of coexisting beneficial microorganism predominantly consisting of lactic acid bacteria, photosynthetic bacteria, yeast, fermenting fungi and actinomycetes that are claimed to enhance microbial turnover in soil and thus known increase soil macronutrients and increases plant growth and yield. and treatment of sewages or effluents. In the present study the EM formulation was evaluated for reduction of of Alkalinity, Total dissolved solids, Biological oxygen demand, and Chemical oxygen demand of domestic sewage under standard condition. All the parameters that were tested showed distinct reduction. But total hetrototropic bacterial and yeast population was increased. No change in fungal and actinomycetes population was recorded.The result of the experiment shows that EM has the potential to improve the effectiveness of treatment of domestic wastes.

Keywords: Effective Microorganism, Domestic water, Waste water treatment

Introduction

The technology of effective microorganisms was developed during the 1970's at the University of Ryukyus, Okinawa, Japan. Studies have shown that EM may have a number of applications, including agriculture, livestock, gardening & landscaping, composting, bioremediation, cleaning septic tanks, algal control & household uses. The practical application was developed by Professor Teuro Higa. He has devoted much of his scientific career to isolating & selecting different microbes for beneficial effects on soils & plants. He has found microbes that can coexist in mixed cultures & are physiologically compatible with one another. When these cultures are introduced into the natural environment, their individual beneficial effects are greatly magnified in a synergistic fashion Crawford, 2002) A microbial inoculant containing many kinds of naturally occurring beneficial microbes called 'Effective Microorganisms' has been used widely in nature and organic farming (Diver, 2001). The concept of Effective Microorganisms was developed by Japanese horticulturist Teuro higa from the University of Ryukyus in Japan. He reported in the 1970s that a combination of approximately 80 different microorganisms is capable of positively influencing decomposing organic matter such that it reverts into a life promoting process. The Studies have shown that EM may have a number of applications, including agriculture, livestock, gardening landscaping, omposting, bioremediation, cleaning septic tanks, algal control and household uses (Higa, 1985). The application of EM will improve soil and irrigation water. It can be used in seed treatment. It can be used to make organic sprays for the enhancement of photosynthesis and control of insects, pests and diseases (Successful use of EM depends on suitable formulation techniques. The formulation method increased their persistence and dependability on the prevailing environmental condition and offered protection against unfavourable environmental condition. Moreover EM can show better performance if they are mixed with suitable ingredients which may act as nutrients, adhesives or wettable agents (javaid *et al*, 2008). The use of effective microorganisms (EM) for reducing volumes of sewage sludge has often been suggested as feasible in either wastewater treatment plants or on-sitewastewater treatment systems such as septic tank and industrial effluents. In the present study, effective microorganism was evaluated for dometic sewage water treatmet efficacy under laboratory condition

Materials and Methods

Effective Microorganism (EM)

Effective microorganism (EM) used in this study was supplied by Environ Biotech as EM stock liquid culture contained a mixture of lactic acid bacteria *Lactobacillus planetarium* (1.0 X10 ^{4}) yeast with 1.0X10 ^{5} CFU/ml *Candida utilis*, actinomycetes *Streptomyces albus* (3.0X10^{3} CFU/ml), fermenting fungi *Aspergillus oryzae* (1.1X10^{5} CFU/ml).EM solution is a yellowish liquid with a pleasant odour and sweet sour taste with a pH of 3 and stored in cool place without refrigeration

Activating the Effective Microorganisms (EM)

EM is available in a dormant state and requires activation before application. Activation involves the addition of 7 L of chlorine free water and 1.5 kg of brown sugar to 3 L of dormant EM one week prior to application.These ingredients were mixed together in either a 15 L or 20 L container and stored in areawith minimal temperature fluctuations. A major influence on the survival of microorganismsis the temperature of their environment, with significant temperature fluctuations impacting upon their survival. The pH is also a etermining factor. It was indicated that the pH of theEM should be approximately 4.5

Treatment

The laboratory experiment was conducted to evaluate the effect of EM on domestic waste treatment with ten replicates and untreated control. The setup consists of 2l Erlenmeyer flask with 1 litre of dometic sewage.100 ml of activated EM culture was added into the sewage sample. The setup was operated continuoustly for 20 days. EM was added each day at the dilution rate of 1:10,000 for five days. The effect of EM was assessed by changes in the pH, alkalinity, Biological oxygen demand, chemical oxygen demand, total dissolved solids after the incubation period in the EM treated sewage sample (APHA, 1989)

Determination of heterotrophic microbial population

Total heterotrophic bacterial, actinomycetes yeast and mold population was studied both control and treatment with serial dilution technique. 1 ml of the sample taken at the respective time interval was serially diluted and 1 ml of respective aliquot were added in the sterile Petri plates, 20 ml of sterile molten nutrient agar, starch casein agar and potato dextrose agar was poured. The plates were incubated at 37^{o}C for 24 hrs (bacteria), 30^{o} C for 4 days.After the incubation period.colony count was recorded.

Results and Discussion

A major problem facing municipalities throughout the world is the treatment, disposal and/or recycling of sewage sludge. Generally sludge from municipal waste consists mainly of biodegradable organic materials with a significant amount of inorganic matter (Elliot 1986). However, sludge exhibits wide variations in the physical, chemical and biological properties (Colin *et al.* 1988; Bruce 1990). At the present time, there are a number of methods being used to dispose of sewage sludge from disposal to landfill to land application. Although there are many methods used, there are numerous concerns raised regarding the presence of constituents including heavy metals, pathogens and other toxic substances. This requires the selection of the correct disposal method focussing on efficient andenvironmentally safe disposal. New technologies are being produced to assist in the treatmentand disposal of sewage sludge, conforming to strict environmental regulations. One of

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thesenew technologies being proposed is the use of Effective Microorganisms (EM).The technology of Effective Microorganisms (EM) was developed during the 1970's at theUniversity of Ryukyus, Okinawa, Japan (Sangakkara 2002). Studies have suggested that EMmay have a number of applications, including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control and household wastes. In the present study, EM treated domestic sewage showed distinct reduction in all the tested parameters under all the tested incubation period. Total dissolve solid was found to be reduced from 2160mg/lit to 1012, 940 and 901 mg/lit pH was also reduced from 9.0 to 8.4,7.4 and 7.1 alkalinity was reduced from 59 mg /lit to 41, 37 and 21 mg/lit. The BOD was reduced from 2.8 to 2.1, 1.5 and 0.9 .No reduction was observed in DO content. The COD was decreased from 164 to 141 112 and 109mg/litre at the respective incubation time.But the total heterotrophic microbial population mainly bacteria and yeast was increased in all the tested time intervals in the EM treated sample than the untreated control (Table 2). There was no significant change was observed in mold population.Bacterial population was increased from $11.2X10^4$ to $23.1X10^5$, $4.0X10^6$ and 41.2X10 7CFU/ml. Yeast count was increased from $41.1X10^3$ to $54.1X10^3$, $6.0X10^4$ and $27.1X10^5$ CFU/ml. 12.0 $X10^3$, $34.1X10^3$, $01.2X10^4$ and 54.1X10 ^{4} CFU/ml fungal population was recorded in the respective tested time period.

Table 1 Changes in parameters of domestic sewage treated with Effective Microorganism (EM)

S.No	Parameter	Incubation time (Days)			
		0	5	15	20
1	pH	9.0	8.4	7.4	7.1
2.	Alkalinity (mg/l)	59.0	41.0	37.0	21.0
3	Dissolved oxygen (mg/l)	1.0	1.0	1.4	1.7
4	BOD (mg/l)	2.8	2.1	1.5	0.9
5	COD (mg/l)	164	141	112	109
6	Total dissolved solids (mg/l)	2160	1012	940	902

Table 2. Changes in microbial population (CFU/ml) of EM treated domestic water

.No	Microorganism	Incubation time 9Days)			
		0	5	15	20
1	Bacteria	$11.2X10^4$	$23.1X10^5$	$4.0X10^6$	$41.2X10^7$
2	Actinomycetes	$2.4X10^2$	$34.1X10^2$	$45.3X10^2$	$51.1X10^2$
3	Mold	$12.0 X10^3$	$34.1X10^3$	$01.2X10^4$	$54.1X10^4$
4t	Yeast	$41.1X10^3$	$54.1X10^3$	$6.0X10^4$	$27.1X10^5$

Organic materials within wastewater originate from plants, animals or synthetic organiccompounds, and enter wastewater via a number of routes including human wastes, detergents, and industrial sources (Taylor *et al*. 1997). In the current wastewater treatment process (eithermunicipal or domestic on-site) microorganisms play a significant role in the treatment ofdomestic sewage. Many different organisms live within the wastewater itself, assisting in thebreakdown of certain organic pollutants (Taylor *et al*. 1997)..The basis for using these EM species of microorganisms is that they contain various organic acids due to the presence of lactic acid bacteria, which secrete organic acids, enzymes, antioxidants, and metallic chelates (Higa & Chinen 1998). The creation of an antioxidant environment by EM assists in the enhancement of the solid-liquid separation, which is the foundation for cleaning water (Higa & Chinen 1998). One of the major benefits of the use of EM is the reduction in sludge volume. Theoretically, the beneficial organisms present in EM should decompose the organic matter by converting itto carbon dioxide (CO2), methane (CH4) or use it for growth and reproduction. Studies have suggested that this is the case for both wastewater treatment plants and also septic tanks. Thisis highlighted by Freitag (2000), who suggests that introducing EM into the anaerobictreatment facilities helped to reduce the unpleasant by-products of this decomposition andalso reduced the production of residual sludge. These factors tend to suggest that theoreticallyEM should assist in the treatment of wastewater by improving the quality of water dischargedand reducing the volume of sewage sludge produce.

References

APHA 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th Edn, Eds A.D.Eaton, L.S. Clesceri & A.E. Greenberg, American Public Health Association, Washington, DC.

Bruce, A.M. 1990, 'Sewage Sludge Processing: Progress and Problems', in *Sewage Treatment andUse of Sewage Sludge and Liquid Agricultural Wastes*, ed P. L'Hermite, Elsevier Applied Science.

Colin, F., Leschber, R., & Mininni, G. 1988, 'Physical and chemical characterisation of sewage sludge', in *Sewage Sludge Treatment and Use: New Developments, Technological Aspects* *andEnvironmental Effects*, eds A. H. Dirkzwager & P. L'Hermite), Elsevier Applied Science

Crawford, J.H. (2002). Review of composting. *Process Biochemistry, 18*, 14-15.

Diver , S. (2001). Nature Farming and Effective Microorganisms**.** Retrieved from Rhizosphere *II: Publications, Resource Lists and Web Links from Steve Diver* http://ncatark.uark.edu/~steved/Nature-Farm-EM.html

Elliott, H.A. (1986) 'Land Application of Municipal Sewage Sludge', in *Journal of Soil and Water Conservation*, (41) pp 5-10.

Freitag, D.G. 2000 (updated 3 May 2000, accessed 27 Aug 2002), 'The use of Effective Microorganisms (EM) in Organic Waste Management' *Effective Microorganisms @ emtrading.com*,http://emtrading.com/em/htmlpapers/emwasterepfreitag.html9.

Higa, T. (1995). *What is EM Technology*. Okinawa, Japan: University of Ryukyus, College of Agriculture.

Higa, T., & Chinen, N. (1998). *EM treatment of odor, wastewater, and environmental problems*. Okinawa, Japan: University of Ryukyus, College of Agriculture.

Sangakkara, U.R. (2002). *The technology of effective microorganisms: Case studies of application*. Cirencester, UK: Royal Agricultural College.

Taylor, C., Yahner, J., Jones, D. & Dunn, A. 1997, 'Wastewater' in *Pipeline*,8(4).