# Review on Domestic Waste Water Treatment By Using Effective Microorganisms Technology

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***Abstract-*** *This paper provides a review of domestic wastewater treatment by using Effective Microorganisms Technology. It includes insights from papers collected and referred to during research work on Effective Microorganisms Technology. Different researchers have concluded that Effective microorganisms are having the ability of wastewater treatment. After activating the Effective Microbial solution it is then added to the wastewater it than undergo the treatment process. The treated water is then used in gardening, farming, and other sectors. This technology is adopting naturally occurring microorganisms and they are not harmful and it is safe to use the treated water.*

***Keywords-*** Effective microorganisms, domestic waste, wastewater, treated water, treatment.

## I. INTRODUCTION

Nowadays, waste treatment is extremely vital because scores of waste is generated per day.Several scientific techniques are discovered for the treatment of waste and then disposal into the natural reservoirs. Among them, domestic waste treatment is extremely troublesome and challenging for local authorities or municipalities. Effective microorganism (EM) technology is taken into accountas an effective method for domestic wastewater treatment. Effective microorganism Technology has several applications including agriculture, livestock gardening, and landscaping, composting, bioremediation, cleaning the septic tank, algae control and household uses. EM is consists of naturally occurring beneficial microorganisms in the form of liquid solution.EM is even effectively used for eliminating the bad odours from the wastewater. At the start of the treatment process the result is a smaller amount, but as the wastewater system is restored to more biological, bad odour is going to be reduced to zero. This paper deals with the study of domestic wastewater treatment by using effective microorganism Technology. Information is collected from published research works of various authors from different parts of the globe.

## II. LITERATURE REVIEW

The reduction and recycling of domestic solid and wastewater have become the main problem in the present-day life of everybody (PatoleDipali et. al., 2020). Kitchen waste is one of the typical household wastes which showed a serious impact on municipalities for the treatment of the same. Even it is not possible to treat most of the waste at the local level. Therefore, it is essential to use techniques that may convert the waste into a useful by-product. One of them is Effective microorganism (EM) technology which may be utilized for the treatment of different types of waste to convert them into useful by products. EM Solution is activated by using jaggery water and chlorine-free water and after activating the EM solution then different tests are conducted to investigate the physical and chemical properties of treated waste. The setup was operated incessantly for 21 days. The result of EM was assessed by changes within the odour, pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), after the incubation period. Test results indicate that there was a definite decrease in the above parameters under all the tested incubation period.

Effective Microorganisms (EM)may be used as microbial inoculants because it is containing several kinds of naturally occurring beneficial microbes (Smitha Mathews and R. Gowrilekshmi, 2016). Maple EM-1 is activated using rice water and jaggery separately.EM solution is a brownish liquid with a pleasant odour and sweet-sour taste with a pH of 3 and it is stored in a cool place without refrigeration before activation. Temperature, pH, Salinity, Dissolved Oxygen (DO), Conductivity, and TDS (Total Dissolved Solids) were measured by taking each sample in separate beakers (60-70 ml) and analyzed using Systronics Water Analyser 371. Fruit and vegetable wastes (Banana, orange, apple, cauliflower, carrot, brinjal, etc.) were collected from retail fruit and vegetable shops and delivered to home immediately before indigenous decomposition. Salinity increase in the EM treated samples than control appeared to be related to the effective production of leachate by EM organism. DO will increase as time goes and at the end of the 28$^{th}$ day a minimum of 1.8 ppm increase is seen in each sample. A smell resembling alcohol and the vinegar-like smell was found during the process which is a non-offensive smell. A declining trend was observed in the chemical properties of waste, such as pH, TDS, and BOD. Salinity, conductivity, and Dissolved Oxygen (DO) showed increased values. Where as analyzing the biological parameters a gradual decrease in Non-EM organisms was seen.

Effective microorganisms (EM) are even used for reducing volumes of sewage sludge (Smitha Mathews and Denna Mary Tom, 2016). It is a feasible wastewater treatment technology. The organisms such as lactic acid bacteria, photosynthetic bacteria, fermenting fungi, yeast, and actinomycetes present in EM could eliminate the volumes of sludge produced, with consequently lower cost and decreased impact upon the environment. Five samples were taken for the experiment, where one was control. EM activated in jaggery and rice water and expired EM activated jaggery and rice water were taken for the experiment. Results from the experiment showed that there is a reduction in pH levels with the improved settlement of sludge and a significant decrease in BOD. There is an increase in the dissolved oxygen content,conjointly rise in the conductivity of the water samples. However, there was no reduction within the total dissolved solids content within the effluent.

Food waste management has become one of the global environmental issues (Siti Aminah Ab Muttalibet. Al, 2016). The composting process can effectively decompose the organic matter by using microorganism under certain moisture, aerobic or anaerobic conditions to produce a product in a form of powder (i.e. the compost) which are stable, low in moisture and free from a pathogen (Soares et al., 2013). The byproduct of the composting process is rich in nutrients like potassium, nitrate, sodium, calcium, magnesium, and chloride so it can be applied directly to soil as a bio-fertilizer for plant growth (Khan and Ishaq,2011). Effective microbes (EM) can be used in food waste composting. It was necessary to investigate the EM properties and the quality of compost with EM in terms of nutrient content and heavy metals concentration. Effective microorganisms consist of varieties of organisms that are safe for all living beings as well as safe for the environment. There are neither toxic nor pathogenic. By considering a multi-culture, 80% will be the coexisting beneficial microorganisms. After investigation of more than 2000species of microbes in different environments,it is found that the effective microbes mainly are lactic acid bacteria, yeasts, Actinomycetes, Photosynthetic bacteria, and fungi (Xu, 2001; (Mayer et al., 2010).

EM technology had a fascinating effecton solid waste management with its conversion into a desirable eco-friendly byproduct (D. K. Kale and P.D. Anthappan, 2012). Supported the result obtained from solid waste treatment, it absolutely was terminated that the utilization of EM technology brought a big rise in organic matter, nitrogen, phosphate, and potassium content of waste that was additionally ascertained by Sayed (2003a,b) and Sekeran et al. (2005). The current study suggests that the treatment of kitchen waste may cut back a load of solid and liquid wastes at massive scales by municipalities. The result of the current study further confirms that solid waste samples, organic matter, nitrogen, phosphate, and potassium content were considerably increased as indicated by previous investigators (Higa and Parr, 1994; Higa 1995). The present technique is thesimplest way to convert the waste into a byproduct which will be utilized as an eco-friendly soil fertilizer.Along with Solid waste management, different problems like waste recycling, then its treatment similarly its disposal, further pollution control and thereby prevention, then wastewater reuse all have become the foremost vital problems. They are of prime concern for every nation as well as globally. Recycling wastewater is sometimes a multi-stepped process (Emad A Shalaby, 2011). It involves more than one step. The first step is the primary treatment, also known as the preliminary treatment method. It is a physic-chemical treatment process. The second step is the secondary treatment which is usually employed to get rid of the objectionable properties of effluent. Additionally it is also called the Biological treatment method. The process involves including the microorganisms under a controlled climate to bring about the biological degradation of organic material present in the effluent. Both suspended as well as the dissolved organic impurities are treated with help of microorganisms.

Biological treatment can be accomplished in many ways, however the essential characteristic of the system is that the use of mixed microbial culture: bacteria, fungi, and/or algae, for the conversion of pollutants. Subsequently the organic content will be oxidized and result into unleash of $CO_2$ and therefore the sludge formation. The organic materials serve as energy and carbon sources for cell growth. A major problem facing municipalities throughout the world is the treatment, disposal, and/or recycling of sewage sludge. The Municipal waste sludge compromises mainly of the degradable material of organic origin along with significant amount of inorganic part. However, sludge exhibits wide variations in the physical, chemical, and biological properties. At present, many methods have been employed to dispose of sewage sludge from disposal to landfill for land application. Even after using these methods the prime concern it still about the presence of heavy metals, pathogens, and other toxic substances. Thus, there is a necessity for developing a technology capable enough to treat the waste in economicalt manner and as per the environmental safety norms.

One such operating model was testedat the domestic sewage treatment plant (STP) by the investigators. (D. Kannan and S. V. Kumar, 2012). Extended EM was prepared by dissolving 1 liter of inactive EM solution in the aqueous jaggery solution at a ratio of 1:19. The prepared solution mixture was kept in an air-tight plastic can to avoid any air contact and it was kept in dark for a week to avoid exposure to the sunlight. Occasionally the air from the solution was released by removing the lid of the plastic can. This provided with resultant extended EM solution. Then fermented EM Bokashi was prepared by adding 1 liter of prepared extended EM solution in 4 kg of zeolite (sodium aluminum silicate). The mixture was then converted into bokashi i.e. a ball shape structure each weighing about 100 gm. This bokashi ball was rolled in teak leaf, afterward stored in an airtight plastic container, and kept away from daylight for about 5 days allow for fermentation and then the proliferation of EM.

Such type of EM bokashi was used for the treatment of domestic waste in the treatment unit under study. So the prepared EM Bokashi balls were added to the domestic effluent inflow tank. Both under aerobic as well as anaerobic conditions the EM technology can be effectively used for the treatment of waste. EM used helped to reduce the toxin level of the analyzed water. There was a 40% reduction in the values of Acidity, alkalinity, total hardness, total dissolved solids, and BOD levels as compared to influent solution. Also, there was a significant change in properties between initial and post-treated water samples. It was also evident that EM could significantly oxidize the organic ingredients and lower down the TDS and BOD values.EM bokashi method was even compared with activated sludge treatment, used in wastewater recycling (Howard et al., 2004). Based upon the investigation results the EM is capable of oxidizing the organic substances from the effluents.

Application of EM supposedly leads to increases in themicrobial biodiversity of soils which boosts their quality and therefore the growth, yield, and quality of crops (Higa and Parr, 1994).Bokashi is the Japanese term for "fermented" organic matter and is equivalent to compost employed in traditional organic farming that is usually prepared with the addition of EM. Both options i.e. anaerobic and aerobic conditions can be prepared. It is seen that partial anaerobic conditions developed within the core of compost pit whereas the outer layer remains in aerobic state. So for the prepared specimen, the anaerobic Bokashi is prepared in closed containers and aerobic Bokashi is prepared similar to traditional composting method.

Addition cover of jute bag, straw mat, etc can be used (Kyan et al., 1999). Enhanced decomposition of plant material after the addition of EM during Bokashi production has been proposed as an innovative approach that allows the odorless breakdown of banana residues in as little as three weeks and therefore the facilitation of rapid recycling of plant nutrients (Shintani and Tabora,2000). Even after the extensive research work in EM technology still the exact composition of EM is not explored. Many described effects are to be investigated in detail. Even the EM solution preparation methods and the storage conditions are to be studied (Higa and Parr, 1994; Wood et al., 1998; Xu et al., 2000). Although little, but this available research work can be used as a basis for further research work. The bacterial and fungal classification must be investigated for handling the waste disposal problems.

It is currently evident that effective microorganisms (EM) are a mixture of different varieties of beneficial microorganisms, consisting of a wide range of applications (Beate Formowitzl et. Al., 2007; Higa, 2002). The concept of EM technology was developed four decades back in the early 1980s by Tiruo Higa, working as a Professor at the University of Ryuky in Okinawa, Japan. He developed this effective treatment method. But he never disclosed the exact composition of the EM solution which he sold commercially. Later Kyan et al. (1999) were able to find that EM is composed of lactic acid bacteria, photosynthetic bacteria, yeasts, and Actinomycetes. Then as per Daly and Steward(1999), EM consists of about 105 varieties of microorganisms. It particularly consists of Streptomyces albus, Propionibacteriumfreudenreichil, Streptococcus lactis, Aspergillusoryzae, Mucorhiemalis, Saccharomyces cerevisiae, Candidautilis, Lactobacillus, Rhodopseudomonas sp., and Streptomyces griseus.

Effective Microorganisms is a mixture of a group of organisms that has a reviving action on humans, animals, and the natural environment. There are numerous anaerobic and aerobic microorganisms thriving in coexisting manner for effective treatment of organic matter (Nathan Szyanski and Robert A Patterson, 2003; Higa 1995). One of the major benefits of the use of EM is the reduction in sludge volume. Conjointly the EM is capable enough to decompose the organic matter within waste and reduce down to $CO_2$ and $CH_4$. This will be further mixed with soil for plant growth. Freitag (2000) investigated that using EM for anaerobic treatment facilities helped to reduce the odours and effluent break down by decomposition process. It also helped to reduce the production of residual sludge. Thus this EM technology is employed in the treatment of wastewater. It will facilitate to get rid of objectionable materials from wastewater discharged. The results showed that EM had a minimal effect on the solids content within a wastewater treatment plant.

Day by day there is an over whelming freshwater deficiency and it is showing the worldwide impact. Population exploitation along with different human activities has led to water crises and depletion of water resources. This has served as a motivation for the researchers to think about developing radical and cost effective solutions to deal with this water crisis. One such solution was treatment of wastewater from domestic and industrial use which can be then reused for different activities.

It can even be used for agriculture only after removal of toxic pollutants that may be present in it. In this context polymer composites can be used for water treatment. (Manar El-Syed Abdel Raouf, 2019). These polymer composites can be derived from natural polymers and it can serve as effective wastewater treatment and reuse technique. It will serve as a sustainable and environment friendly water treatment solution

India is facing different water and effluent issues and water-related health hazards. Almost 80% of the supplied for domestic use, comes back as wastewater (Kulkarni V. et. al, 2019; Venkata Siva Rama Prasad, 2020). In most cases, untreated wastewater is let out which either sinks into the ground as a potential pollutant of groundwater or is discharged into the natural drainage system causing pollution in downstream areas. Sewage Treatment Plants (STPs) are set up to receive the load of wastewater, further threat them, reduce the objectionable characteristics upto reasonable level and then treated water can be released in the natural water bodies. This will certainly help to crib the pollution treat on the water bodies. It will maintain the aquatic environment both aesthetically and well as it will protect the eco system.

Seekaran V. (2005) performed the experimental analysis by adopting the composting technique for treating the kitchen wastes using effective microorganisms (EM), which results in a higher decomposition of organic matter and no odor during the process. The sample that was used for composting was collected from the college campus, which includes the wastes from the canteen and hostels. The study revealed that wastes provided a better environment for the effective microorganisms (EM) to grow and produced a higher quality of compost. Organic matter helps in soil management for sustainable cultivation of any crop

The adaptation of effective microorganisms (EM) leads to detoxification of our landfills, decontamination of our environment and promotes highly sustainable, closed-cycle agricultural and organic waste treatment.

## III. CONCLUSION

Based on the present review it could be suggested that treatment of Kitchen waste will reduce a load of solid and liquid waste on large scales especially on the Waste handling system and particularly for Municipal treatment plants. Also, it was found that Kitchen waste could severe a better environment for the growth of effective microorganisms and produce a higher quality of compost manure. Adopting an effective microbial treatment method would lead to detoxification of the landfills and at the same time it would cause the decontamination of the environment. Few of the past work also promotes the use of highly sustainable, closed-cycle agricultural and organic waste treatment processes. But the use of effective microorganism Technology has shown the desired effect and there is a significant decrease in the content of organic matter, nitrogen, phosphate, and Potassium content of waste which has also been observed.

## IV. ACKNOWLEDGEMENT

We would like to acknowledge the Management and faculties at DVVP College of Engineering, Ahmednagar who have contributed to the development of this review paper.

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