The Effect of EM on the Removal of Bad Odor from Waste Water of Fish Fillet Factory

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Abstract

The main objective of this work was to treat wastewater of Min Zar Ni and A Saung Kaung fish fillet factories by effective microorganisms (EM) to reduce the bad odor. The physicochemical parameters such as odor, appearance, color pH, electrical conductivity (EC). total dissolved solids(TDS), dissolved oxygen(DO) and temperature of before and after treatment of effective microorganisms(EM) on waste water from Min Zar Ni and A Saung Kaung fish fillet factories were examined at an interval of 7 days. Physicochemical parameters of waste water samples were analyzed for 4 weeks. The results of the present study showed that the waste water samples induced with EM achieved the removal of bad odor within 9 days and color starts to clear and more transparent through the third week of the trial. The results showed that efficiency of 500 mL effective microorganisms (EM) treatment on electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO) in waste water of Min Zar Ni were 34.91%, 33.33% and 13.98% . Efficiency of 500 mL effective microorganisms (EM) treatment on electrical conductivity (EC), total dissolved solids(TDS), dissolved oxygen(DO) in waste water of A Saung Kaung were 27.19%, 24.91% and 1.12%. While when the EM dose was increased from 100 mL to 500 mL, the pH of Min Zar Ni and A Saung Kaung were changed from higher alkaline condition to nearly neutral condition, such as pH =7.04 for Min Zar Ni and pH =7.45 respectively, after completion of four weeks. It can be concluded that the effective microorganism (EM) can be used as the way to treat wastewater of fishery fillet factory to help reduce the problem of bad odor and water pollution before releasing into Tenanssery River.

Keywords : Effective microorganisms, fishery fillet wastewater. bad smell

1.Introduction

Water pollution due to discharge of untreated industrial effluents into water bodies is a major problem in the global context (Mathuthu *et al*., 1997). The problem of water pollution is being experienced by both developing and developed countries. Human activities give rise to water pollution by introducing various categories of substances or waste into a water body. The more common types of polluting substances include pathogenic organisms, oxygen demanding organic substances, plant nutrients that stimulate algal blooms, inorganic and organic toxic substances (Cornish and Mensahh**,** 1999). In the vast majority of cases, however, impairment of water quality is either directly or indirectly the result of human activities (Dunbabin and Bowmer, 1992). Both the nature of a pollutant and the quantity of it are important considerations in determining its environmental significance (UNDTCD, 1991). Generally, readily degradable substances are quickly broken down in the environment and are of great concern only when they are discharged. Water pollution due to discharge of untreated industrial effluents into water bodies is a major problem in the global context (Mathuthu *et al*., 1997). The problem of water pollution is being experienced by both developing and developed countries. Human activities give rise to water pollution by introducing various categories of substances or waste into a water body. The more common types of polluting substances include pathogenic organisms, oxygen demanding organic substances, plant nutrients that stimulate algal blooms, inorganic and organic toxic substances (Cornish and Mensahh**,** 1999)**.** At the present time, there are a number of methods being used to dispose of the solid wastes in a landfill. Although there are many methods used, it requires the selection of the correct method focusing on efficient and environmentally safe disposal. New technology is being produced to assist the organic waste treatment, conforming to strict environmental regulations

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(Chennakrishnan *et al.*, 2008). One of those new technologies being proposed is the use of effective microorganisms (EM). The technology of EM was developed during the 1970s at the University of Ryukus, Okinawa, Japan (Sangakkara 2002). Studies have suggested that EM may have a number of applications including agriculture, livestock, gardening and landscaping, composting, bioremediation, cleaning septic tanks, algal control and household uses (EM Technology, 1998). EM consists of the following five families of micro-organisms: Lactic acid bacteria: these bacteria are differentiated by their powerful sterilizing properties. They suppress harmful micro-organisms and encourage quick breakdown of organic substances. In addition, they can suppress the reproduction of Fusarium, a harmful fungus.Yeasts: these manufacture anti-microbial and useful substances for plant growth. Their metabolites are food for other bacteria such as the lactic acid and actinomycete groups. Actinomycetes: these suppress harmful fungi and bacteria and can live together with photosynthetic bacteria.Photosynthetic bacteria: these bacteria play the leading role in the activity of EM. They synthesize useful substances from the secretions of roots, organic matter and/or harmful gases (e.g. hydrogen sulphide) by using sunlight and the heat of soil as sources of energy. They contribute to a better use of sunlight or, in other words, better photosynthesis. The metabolites developed by these micro-organisms are directly absorbed into plants. In addition, these bacteria increase the number of other bacteria and act as nitrogen binders. Fungi that bring about fermentation these break down the organic substances quickly. This suppresses smell and prevents damage that could be caused by harmful insects (Higa, 1988).The aim of the research work is to study the effects of EM on the elimination of smell from the waste water of fish fillet factories.

2.Materials and Methods

The layout of the sample collection sites are Min Zar Ni and A Saung Kaung fish fillet factories in Innlay Myaing Industrial zone, Myeik Township at Tanintharyi region shown in Figure 2.1(a). The collection site of waste water and front view of Min Zar Ni and A Saung Kaung fish fillet factories were as shown in Figure 2.1(b).

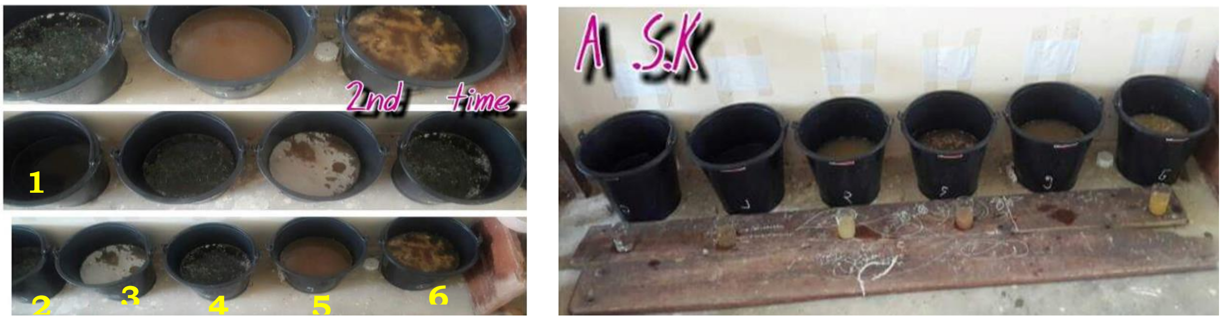
EM solution were prepared by the following procedure. One bin of rice was dissolved in one liter of chlorine free water and stored at room temperature without direct sunlight. After seven days, the fermented rice water was mixed with milk (1:10 ratio). After two weeks, the yellow brown EM solution was obtained and stored in a cool dry place. The aqueous brown jaggery was added into the prepared EM solution and placed out of direct sunlight for 1-2 hours to allow the EM to activate more fully (Higa, 1988).

Two samples of waste water which collected from Min Zar Ni and A Saung Kaung fishery fillet factory were separately added to each six buckets and the content of waste water in each bucket was three liter. One bucket was not treated with effective microorganism (EM). Other Five buckets were treated with effective microorganism. The waste water sample in each five buckets were treated with 100 mL, 200 mL, 300mL 400 mL and 500 mL solution of effective microorganism (EM) .The parameters such as odor ,pH, electrical conductivity (EC), total dissolve solids (TDS), dissolved oxygen (DO) of EM-treated and untreated waste water samples in the six buckets were also analyzed weekly. All EM-treated and untreated samples were taken over the four-week period. The odor of EM-treated waste water and untreated waste water samples were detected by using olfactory judgment. Color change and appearance of EM-treated waste water and untreated waste water sample were detected through visual observation.

(a) (b)

Figure 2.1. (a) Location of Min Zar Ni and A Saung Kaung fish fillet factories in Innlay Myaing Industrial zone

(b) Collection of waste water from Min Zar Ni



(a) (b)

Figure 2.2 (a) Treatment of Min Zar Ni waste water by effective microorganism

(b)Treatment of A Saung Kaung waste water by effective microorganism

The efficiency of treatment was calculated from the results in each parameter. The equation of efficiency is shown in equation; $E = \left[\frac{A_{in} - A_{out}}{A_{in}}\right] \times 100$,where E is efficiency of treatment in each parameter, A_{in} is results before treatment andA_{out} is results after treatment

3. RESULTS AND DISCUSSION

The EM-treated and untreated waste water samples were analyzed for water quality over the past one week, for a total of four weeks. The parameters for the determination of water quality including the odor, pH**,** electrical conductivity (EC), temperature, total dissolved solids (TDS) and dissolved oxygen (DO). The lactic acid bacteria, filamentous fungi yeasts, *Streptomycetes*, and non-EM organisms while photosynthetic bacteria were not measured throughout this study. The results are shown in detailed below. The labels of five buckets for treated waste water sample of Min Zar Ni ,except untreated sample were M-100, M-200, M-300, M-400 and M-500. The label of five buckets for treated waste water sample of A Saung Kaung were AS-100, AS-200, AS-300, AS-400 and AS-500.

3.1 Determination of odor

A strong offensive smells were detected within 9 days in the large dose of effective microorganism (EM) on Min Zar Ni and A Saung Khaung waste water samples .The strong offensive smell (ammonia and hydrogen sulphide) of all effective microorganism (EM) treated samples were disappeared after 9 days for Min Zar Ni and A Saung Khaung samples. This was due to result from photosynthetic bacteria and fungi in effective microorganism (EM). Photosynthetic bacteria in effective microorganism (EM) can fix and utilize CO_2 and H_2S generated in putrefaction process, resulting in removal of the pollutants and offensive odors (Higa,1988). Fungi that bring about fermentation these break down the organic substances quickly. This suppresses smell and prevents damage that could be caused by harmful insects (Higa,1988).

3.2 Determination of color and appearance

The black color was appeared in untreated waste water samples of Min Zar Ni and A Saung Kaung, within 7 days. The color of the untreated waste water samples and effective microorganism (EM) treated waste water samples were shown in Figure 2.2.A white layer like fungi growth (Actinomyces) was observed on the surface of effective microorganism (EM) treated all samples in M-200 and AS-200 buckets within 7 days of process. Actinomyces growth indicates that good fermentation process has taken place. Later occurrence of black layer like fungi on top of effective microorganism (EM) treated all samples in M-200 and AS-200 buckets were observed after 14 days of process. It indicates that contamination has occurred and process had followed a putrefaction pathway rather than fermentation pathway (Smitha Mathews and Gowrilekshmi, 2016), (Higa, and Chinen, 1998).The color of effective microorganism (EM) treated samples in M-400 and AS-400 buckets gradually changes to chalky then to light brown. After 22 days, effective microorganism (EM) treated samples showed a change in color from light brown to clear solution (Smitha Mathews and Gowrilekshmi, 2016),

3.3 Determination of pH in samples within 28 days

The pH of the EM-treated and untreated waste water on the pH of Min Zar Ni and A Saung Kaung waste water were presented in Table 3.1, 3.2, 3.3. In untreated Min Zar Ni waste water, pH is gradually increased within 21 days. The subsequent rise of pH reflected the utilization of the organic acids by microorganisms. After 21 days, pH can be decreased by the carbon dioxide released by the bacteria breaking down the organic wastes (Matovu, 2010). The similar results were found in untreated waste water of A Saung Kaung. The pH of EM- treated Min Zar Ni waste water samples were shifted from initial value of 6.43 towards more acidic condition by producing organic acids within 7 days. Also lactic acid produced by Lactobacillus contributed to the acidic pH. The initial drop in pH reflects the synthesis of organic acids, which serve as substrates for succeeding microbial populations (Higa and Chinen, 1998). After 7 days, the subsequent rise of pH reflected the utilization of the organic acids by microorganisms (Smitha Mathews and Gowrilekshmi, 2016). It can be concluded that value of pH was dependent on the dose of effective microorganism (EM). Moreover, pH of the effective microorganism (EM) treated A Saung Kaung waste water samples were shifted from initial value of 6.98 towards more alkaline condition within 7 days. This was due to the fact that the organic acid was utilized by microorganisms (Smitha Mathews and Gowrilekshmi, 2016). After 14 days, values of pH in all treated samples were gradually decreased. After 28 days, pH value for all effective microorganism (EM) treated waste water samples of A Saung Kaung were found to be the range of 7.54 to 7.84. Linich (2001) also reported that a change in microbial populations may impact upon pH. This tends to support the result obtained, through continual changes in the conditions within the buckets.

3.4 Determination of electrical conductivity (EC) and total dissolve solids (TDS) in samples within 28 days

Electrical Conductivity is a measure of how much total salt is present in the water. The more the ions in solution provided that the higher the electrical conductivity (Mosley *et a*l., 2004**).** The electrical conductivity (EC) of the untreated waste water was as shown in Table 3.1. The effect of effective microorganism (EM) on the electrical conductivity (EC) of Min Zar Ni and A Saung Kaung waste water were presented in Table 3.2,and 3.3. The experimental results from Table 3.1 showed that value of electrical conductivity (EC) in untreated sample of Min Zar Ni was found to be the ranged from 5.90 ms to 7.18 ms. The value of electrical conductivity (EC) in EM- treated Min Zar Ni and A Saung Kaung waste water were increased with the increasing the dose of effective microorganism (EM) solution. The value of electrical conductivity (EC) in AS-500 bucket was 14.78 ms. The high values of electrical conductivity (EC) could be due to release of fresh fish remains and blood containing nitrogenous compounds into their waste effluent, which are nitrified to ammonium-nitrogen and nitrate resulting in high value of electrical conductivity (EC) (Koushik and Saksena, 1999). However, high values of electrical conductivity (EC) in treated A Saung kaung waste water was exceeding permissible limits of 400 µS (WHO / EC guidelines, 1984).

Total dissolved solids (TDS) are a measure of the combined content of all inorganic and organic matter which is found in solution in water. The total dissolved solids (TDS) of the untreated waste water was as shown in Table 3.1.The effects of effective microorganism (EM) on the total dissolved solids (TDS) of Min Zar Ni and A Saung Kaung waste water were presented in Table 3.2, and 3.3. The experimental results showed that value of total dissolved solids (TDS)in untreated Min Zar Ni was found to be less than EM- treated Min Zar Ni and A Saung kaung waste water. In this case, value of total dissolved solids (TDS) was increased with the increasing the dose of effective microorganism (EM) solution. This is due to the fact that the effective microorganism (EM) secretes organic acids and enzymes which acts on waste and degrades complex organic matter into simpler ones. The antioxidant substances produced by effective microorganism (EM) enhances the breakdown of solids and reduces the sludge volume (Higa and Chinen, 1998).

3.5 Determination of dissolve oxygen (DO) in samples within 28 days

The dissolved oxygen (DO) of the untreated waste water and effects of effective microorganism (EM) on the dissolved oxygen (DO) of Min Zar Ni and A Saung Kaung waste water were presented in Table 3.1, 3.2, and 3.3. In untreated Min Zar Ni waste water, dissolved oxygen (DO) was gradually increased within 21 days. In untreated A Saung Kaung waste water, dissolved oxygen (DO) was gradually increased during 28 days. It can be concluded that the organic decomposition did not undergo during the 21 days. After 21 days the dissolved oxygen (DO) was decreased to 9.86. This meant that organic decomposition occurred after 21 days (Hasan *et al*., 2015). The dissolved oxygen (DO) of EM treated Min Zar Ni waste water samples were gradually increased within 21 days. It can be concluded that small amount of organic matter contained in Min Zar Ni waste water. The dissolved oxygen (DO) of the effective microorganism (EM) treated A Saung Kaung waste water sample were smaller than amount of dissolved oxygen in untreated waste water. The dissolved oxygen (DO) of the effective microorganism (EM) treated A Saung Kaung waste water sample were decreased within 21 days. After 21 days, dissolved oxygen (DO) of the effective microorganism (EM) treated was increase slightly. These results may caused the small amount of oxygen was used in the process of oxidizing the organic matter(Hasan *et al*., 2015). It can be concluded that large amount of organic matter contained in A Saung Kaung waste water.

Table 3.1 Parameters of Min Zar Ni and A Saung Kaung Waste Water Samples before the Treatment of Effective Microorganism

sample	week	pH	EC(ms)	TDS(ppt)	DO(mg L^{-1})	Temperature(°C)
Min Zar Ni	initial	6.43	5.90	3.00	8.65	28.7
A Saung kaung	initial	6.98	11.62	5.90	8.00	28.7

Table 3.2 The Effect of Effective Microorganism (EM) on the Parameters of Min Zar Ni Waste Water

sample	week	pH	EC (ms)	TDS(ppt)	DO(mg L^{-1})	Temperature (°C)
Control	first	7.8	6.89	3.43	7.92	27.2
	second	7.89	6.69	3.38	9.75	26.4
	third	7.86	6.91	3.49	10.38	27.5
	fourth	7.84	7.18	3.62	9.86	27.7
M-100	first	4.08	6.57	3.29	8.75	27.2
	second	7.75	6.88	3.45	9.83	26.3
	third	7.84	6.35	3.23	10.9	27.6
	fourth	7.96	7.22	3.62	9.86	27.7
M-200	first	3.49	6.76	3.38	9.46	27.1
	second	4.07	6.73	3.37	10.48	26.0
	third	6.12	7.29	3.65	10.41	27.4
	fourth	7.86	7.41	3.70	9.63	27.7
M-300	first	3.81	6.52	3.27	10.56	27.2
	second	5.39	6.74	3.37	11.27	26.1
	third	7.18	6.99	3.50	11.72	27.4
	fourth	7.14	7.42	3.73	9.90	27.7
M-400	first	3.87	6.47	3.25	9.60	27.2
	second	5.71	7.04	3.52	10.36	26.1
	third	7.45	6.93	3.48	10.96	27.8
	fourth	7.07	7.68	3.86	10.00	27.7
M-500	first	3.52	6.91	3.46	10.69	27.1
	second	3.95	7.05	3.55	10.83	26.1
	third	5.35	7.62	3.83	10.22	27.3
	fourth	7.04	7.96	4.00	9.86	27.4

Table 3.3 The Effect of Effective Microorganism (EM) on the Parameters of A Saung Kaung Waste Water

sample	week	pH	EC(ms)	TDS(ppt)	DO(mg L^{-1})	Temperature(°C)
Control	first	7.97	12.91	6.50	5.42	27.2
	second	7.83	12.98	6.54	6.49	26.4
	third	7.85	13.98	6.90	7.13	27.5
	fourth	7.78	14.16	7.01	7.46	27.7
AS-100	first	8.03	13.05	6.54	5.25	27.2
	second	7.91	13.12	6.57	6.45	26.3
	third	7.88	13.67	6.84	6.99	27.6
	fourth	7.72	14.28	7.11	7.49	27.7
AS-200	first	7.84	13.01	6.51	5.26	27.1
	second	7.87	13.06	6.56	6.38	26.0
	third	7.76	13.71	6.84	7.30	27.4
	fourth	7.69	14.49	7.21	7.89	27.7
AS-300	first	7.88	13.02	6.52	5.28	27.2
	second	7.84	13.00	6.50	6.48	26.1
	third	7.74	13.79	6.92	7.21	27.4
	fourth	7.54	14.72	7.28	7.90	27.7
AS-400	first	7.85	12.97	6.50	5.38	27.2
	second	7.82	13.13	6.57	6.33	26.1
	third	7.57	13.74	6.90	7.27	27.8
	fourth	7.51	14.58	7.30	7.91	27.7
AS-500	first	7.86	12.99	6.49	5.32	27.1
	second	7.8	13.39	6.62	6.32	26.1
	third	7.63	13.74	6.90	7.74	27.3
	fourth	7.45	14.78	7.37	7.92	27.4

4.Conclusion

Based on the experimental programs, the following conclusions have; increased the dose of effective microorganism (EM), increased the removal efficiency of bad odor ,pH, the electrical conductivity (EC), the total dissolved solids (TDS)and the dissolved oxygen (DO). The outcome of the research work is effective microorganism (EM) can play a vital role in depletion of bad odor.

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