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Assessment of suitability of Processing Effluent discharged from Quality Indian Seafood Exporter: Shimpo Exports, West Bengal, India

Mishra Rashmi Prabha[1], Rout Sangram Keshari[2], Kumar Navin[3], Panigrahi Akhaya[4], Mishra Chandrakanta[5] and Mishra Jyoti Prabha[6]

[1]Krishi Vigyan Kendra, Panchamahala, Hulursingha, Angul, Odisha, 759132, INDIA
[2]Dept. of Aquatic Environment Management, Faculty of Fishery Sciences, 5-Budherhat road, Panchasayar, WBUAFS, Kolkata, 700094, INDIA
[3]Fisheries Extension Officer, Muzaffarpur, Bihar, INDIA
[4]CIBA, Chennai, Fish and Fisheries Science, Crustacean culture division, INDIA
[5]Regional Research centre, CIFA (ICAR), ATIC Building, Anand Agricultural University, Borsad Chokadi, Anand Gujarat, 388001, INDIA
[6]Department of Livestock Production Technology, WBUAFS, Kolkata, 700094, INDIA

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Abstract

The present study was aimed to determine the suitability of processing effluent discharged from Shimpo Exports, West Bengal for culture purpose. The rate of reaction of pollutants entering the water or the detrimental effects on the aquatic organisms are generally influenced by various environmental factors such as total alkalinity, hardness, dissolved oxygen, ph, turbidity, temperature etc. In aquatic environment the physico-chemical changes are occurred due to the release of effluents. Discharge of different kinds of waste to aquatic system also creates undesirable changes in fish such as physiological and haematological changes. Therefore, quality of water plays an important role for the survival and development of aquatic animal. All this necessitates the importance to study the physico-chemical parameters of processing effluent discharged to the surrounding water bodies. The experiment was set for 70 days in four treatment groups i.e. *0.25 % (T_1), 0.5% (T_2), 0.75% (T_3) and 1 %(T_4) and one control group i.e. 0% (T_0), with triplicates following completely Randomized Design (CRD). Various physicochemical parameters like colour, odour, pH, DO, hardness, total alkalinity, BOD, COD, phosphate-phosphorous, TS and TDS were determined using standard method. From the results of analysis, it is inferred that the physicochemical parameters were found to be increased from the control set except the dissolved oxygen which was found to be decreased. During the study it was also found out that the effluent characteristics are not within the permissible limits for fish culture.*

Keywords: Sea food processing industry, effluents, physicochemical parameters, shimpo exports.

Introduction

With the increasing trend of health conscious people to consume different types of Fish and Fishery products, more and more Seafood Processing Industries are preparing the products to meet their demand which has resulted in disposal of heavy amount of processing waste to the aquatic ecosystem. These ecosystems are constantly facing the threats of pollution from various types of industrial effluents, agricultural run-offs and urban domestic sewage etc. They suffer from the deleterious effects of effluents originating from these industries. Among the various industries Fish and Fish Processing industry is of national importance and there are over 1400 Processing Plants nationwide. These industrial effluents released into water directly after little or no treatments have added to the problem. Wastewaters released from different Fish Processing plants differ in composition because of the varietal management practices. As each fish processing plant has its own characteristics and standards, it is difficult to estimate the amount of waste water use and generate to the surrounding water bodies. Seafood Processing Plants generate a high volume of effluent which increases as the amount of production increases[1]. This Shimpo Exports consumed 300 to 400 tons of water per day and produced about 100 to 150 tons of waste water per day. About 600 persons are employed in this plant. The types of raw material processed here are Shrimp, Croaker, Shoal fish, Ribbon fish, Pomfret, Hilsa, Pabda and Catfish. The operation methods used in this plant are mainly washing, grading, beheading, peeling, deveining and freezing. Ground water is used as the source of water in this Processing Plant. Waste waters from fish processing industries contain various portions of flesh, skin, bone fragments, fins, shells or liquid stick water. The high biological oxygen demand of the fish processing waste affects the aquatic environment and causes different health hazards if it will not treated in a proper way. In general the solid wastes from the fish industries comprise of 30 to 40 percentage of the total production. Tremendously increasing the discharge of industrial effluents into water body could result in reduced fish metabolic rate and growth. Despite growing interest in the impact of industrial effluents on environment, relatively a little is known about their toxic action particularly in aquatic ecosystems and Fish Processing effluents

also received little research attention. In the present Investigation we mainly characterize the water discharged from Shimpo Exports for assessing its suitability for culture purpose.

Material and Methods

The experiment was set in four treatment groups and one control group with triplicates following Completely Randomized Design (CRD) for a period of 70 days in the wet lab of Department of Fisheries Environment Division, West Bengal University of Animal and Fishery Sciences, Kolkata. The processing plant named "Shimpo Exports" of local area was selected for collection of waste water. After collection of the waste water from the main discharge point of this plant it was kept in a rectangular shaped FRP tanks of 500L capacity. The effluent concentrations selected for the experiment were divided into five groups including (1 control + four treatments) i.e., 0% (T_0), 0.25 % (T_1), 0.5% (T_2), 0.75% (T_3) and 1 % (T_4). All physico-chemical parameters were analyzed by standard method[2]. These parameters were compared by multivariate ANOVA using time and treatment as main factors followed by Duncan's multiple range test (DMRT) between the treatments. All the statistical analysis was performed by using SPSS 17, Chicago, America.

Results and Discussion

In the present investigation the raw processing effluent appears as light pale yellow colour and it have an objectionable and unagreeable odour. But after dilution it becomes transparent and the odour is unobjectionable and agreeable in all treatment groups. During the study, the raw processing waste water was shown so higher values of hardness, biochemical oxygen demand, total solids, chemical oxygen demand and total dissolved solids as compared to tap water table-1. During the analysis of the physico-chemical quality of experimental water it remained fairly congenial table-2. The pH of experimental water varied between 7.51 to 7.56. Dissolved Oxygen contents of experimental media fluctuated between 4.6 and 4.8 mg/l. The levels of hardness were comparatively high in experimental waters indicating the hard nature of the media table-2. A moderate variation in the biochemical oxygen demand and chemical oxygen demand value were visible which ranged between 8.06 to 28.35 and 28.0 to 63.59 mg/l respectively. The values of total solids and total dissolved solids varied between 995.61 to 1042.43 mg/l and 554.05 to 596.21 mg/l respectively.

Fluctuations in water quality parameters i.e. (ph, total alkalinity, hardness, do = dissolved oxygen, bod = biochemical oxygen demand, cod = chemical oxygen demand, po_4-p= phosphate phosphorus, ts = total solids, tds = total dissolved solids) during different treatments of experimental period. Means bearing different superscripts differ significantly. ($p < 0.05$).

During the experimental period, all the physico-chemical parameters analyzed in different treatment groups and on every assay days were found significantly higher ($P<0.01$) than the control group except the dissolved oxygen which was found to be decreased. The reduction of DO content could be probably due to high oxygen demanding processing waste[5]. The low DO content in water could be probably due to the reason that a part of Oxygen is used for the oxidation of organic matter which has resulted the declining content of oxygen.

Table–1
Characterization of Physico-chemical parameters of Tap water and Processing Effluent before dilution

Parameters	Tap water	Processing Effluent
pH	7.3	7.8
DO (mg/l)	4.8	Nil
Total lkalinity(mg/l)	230	252
Hardness (mg/l)	770	980
BOD (mg/l)	1.2	3000
COD (mg/l)	16	4800
PO_4 - P (mg/l)	0.14	0.24
TS (mg/l)	980	6243.32
TDS (mg/l)	540	5621.78

Table-2
Fluctuations in Processing Effluent Parameters during different treatments of experimental period

Water parameter	Treatment				
	Control (T_0)	T_1	T_2	T_3	T_4
pH	7.34^{a}	7.52^{b}	7.53^{bc}	7.53^{bc}	7.56^{c}
DO(mg/l)	4.83^{a}	4.8^{e}	4.75^{d}	4.69^{c}	4.6^{b}
Hardness(mg/l)	770.01^{a}	772.45^{b}	774.9^{c}	777.36^{d}	779.83^{e}
Total Alkalinity(mg/l)	230^{a}	231.25^{a}	232^{a}	232.5^{a}	233.2^{a}
BOD(mg/l)	1.49^{a}	8.06^{b}	15.1^{c}	21.2^{d}	28.35^{e}
COD(mg/l)	16.82^{e}	28.03^{a}	39.79^{b}	51.98^{c}	63.59^{d}
PO_4 - P (mg/l)	0.14^{a}	0.141^{b}	0.143^{c}	0.145^{d}	0.146^{d}
TS(mg/l)	980^{a}	995^{b}	1011.21^{c}	1026.8^{c}	1042.43^{c}
TDS(mg/l)	540^{a}	554^{b}	568^{bc}	582^{cd}	596^{d}

The most important indicator of pollution in a water quality is the Water pH, which express the intensity of the acidity or alkalinity. In this study, more pH value was due to the alkaline materials used in the processing plant for washing purpose. slightly alkaline ph values of processing waste have also been reported by various researchers[3-4]. Throughout the study period the higher hardness concentration might be due to presence of minerals i.e. iron, aluminium etc. from the ground water source used in the seafood processing plant[6-7].

Total alkalinity of natural water is generally the result of carbonate and bicarbonate ions, because carbonate minerals are abundant in nature. Increased alkalinity values were probably due to the addition of organic matter rich processing waste. The organic matter rich processing waste was responsible for increase in the carbonate and bicarbonate values which lead to shift in alkalinity value[8]. BOD is the most reliable parameter for judging the extent of pollution in the water[9]. The high BOD value could be probably due to presence of more organic material in waste water[10-11]. The reason for the high values of BOD might be also due to less water consumption by the studied processing plant[12]. High BOD may also be due to low DO content. COD measures indirectly the pollution strength of waste water or liquid. In this investigation, COD levels were higher than the BOD in all the treated waste water. This result revealed that aquatic products plant waste water is strong and fluctuating by nature[13-14]. High COD values of treated waste water may be due to occurrence of huge amount of organic content in the waste water. This also indicates that the organic matter of processing wastewater contains a large amount of biologically resistant substances. Similar results have been observed by various workers[7-10]. The Phosphorous in aquatic products processing industries is mainly found in inorganic forms; such as polyphosphate and orthophosphate and also in organic forms[15]. High Phosphorous content of this experimental water is due to the organic matter abundant fish processing waste. The Total Solids give an organic load measured as BOD and COD[10]. The Fish Processing industries generate large quantities of solid wastes which include whole waste fish, offal, gut content, Viscera and fish scraps. Shells, scales and appendages constitute a bulk of the solid in the Seafood Processing Plants[11]. The higher Total Solid content of water throughout the observations is comparable to findings of various researchers[13-16]. The Dissolved Solids are responsible for the true colour production in waste water[17]. In the present investigation the Total Dissolved Solid content of the treated wastewaters were higher than the control. Similar results have been observed by various researchers[13-14]. During the present observation the total dissolved solid content is high and close to the total solid content, which might be due to the waste waters contained solids mostly in soluble forms[16].

Conclusion

In the light of present findings it can be inferred that there is a clear cut variation in the physico-chemical parameters of processing effluent. The present study also states that these parameters are varying in different manner. Even many parameters are interdependent on their changing pattern. For example, Dissolved oxygen was inversely correlated with all other water parameters. The increased values of most of the parameters analysed were not within the permissible limits for culture purpose. So the findings clearly indicated that the processing effluents were not suitable for aquatic life. Therefore, proper treatment of processing Effluent prior to release in the neighboring water bodies were strongly suggested to protect aquatic environment.

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