

PHYSICOCHEMICAL ANALYSIS OF EFFLUENT DISCHARGE OF FISH PROCESSING INDUSTRIES IN RATNAGIRI INDIA

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ABSTRACT

Effluents from fish processing industries are the major sources of coastal environmental pollution. The present study represents the characteristics of effluent from fish processing industry. Water samples were collected from different places located at *Mirkarwada* and *Mandavi* where waste water discharged in. The periodic physicochemical analysis of effluent to assess the quality of effluent has been carried out. The parameters such as temperature, pH, conductivity, TDS, BOD, COD, DO chlorides and hardness of the water have been studied using standard protocol APHA. The physicochemical analysis reveals that all the samples are polluted and having the values higher than the permissible limits. Some remedial steps to be taken for avoiding water pollution.

Key words: Effluent, Physicochemical, Pollution, Water quality

INTRODUCTION

Various devastating ecological effects and human disasters in the last 40 years have arisen majorly from industrial wastes causing environmental degradation (Abdel-Shafy and Abdel-Basir, 1991; Sridhar *et al.*, 2000). The discharges from these industries constitute biohazard to man and other living organisms in the environment because they contain toxic substances detrimental to health (Adebisi *et al.*, 2007; Adriano, 2001; Bakare *et al.*, 2003). Recently, there has been an alarming and worrisome increase in organic pollutants (Nadal *et al.*, 2004). Since many effluents are not treated properly, these products are discharged on the ground or in the water bodies and most of these discharges to water bodies accumulate in the system through food chain (Odieta, 1999).

The waste water discharge from industries are major source of pollution and affect the ecosystem (Morrison *et al.*, 2001). The degradation of environment results by the adverse effect of industrial waste on living organism and agriculture (Anikwe and Nwobodo, 2006). Ratnagiri is famous coastal city for producing commercial fish in Maharashtra. There are total 30 fish processing industries processing various fishes released effluent openly at *Mirkarwada* and *Mandavi* sites. Fish processing is divided into two major categories as fish handling and fish product manufacturing. Surimi is the product intended to mimic the meat of lobster, crab and other shellfish. Fish oil is recommended for healthy diet. Fish glue is made by boiling the skin, bones and swim bladder of fish.

Fish meal is made from whole fish and bone from processed fish.

The products of industries are usually sold wholesale to grocery chain or to intermediates which provides 50 % jobs therefore, from the economic and social perspective, fish processing industries are main pillar in the development of Ratnagiri city. Fish harvesting and fish processing is a main income of the people residing in this area. Small scale industries are not capable to produce acceptable effluent quality. Several techniques are used for treatment of wastewater from fish and surimi industries (Wu. *et al.* 2002). During the production of such various food products, organic rich waste is generated both the solid and liquid. The huge amount of organic pollutants in waste water causes putrefaction of sewage sludge, mainly due to protein presence and makes the efficiency of activated sludge much more. This study is aimed to assess the levels of some physicochemical parameters effluent discharge of fish processing industries in Ratnagiri, Maharashtra.

MATERIAL AND METHODS

The selected area for this analysis was *Mirkarwada* and *Mandavi* beach; both are coastal regions with tropical climate. Waste water samples were collected from these sites where the effluent from various fish processing industries released openly. The sampling points were designated as S1 to S4. Samples were collected with the help of clean plastic container well cleaned with non ionic detergent, rinsed with tap water and finally washed with deionised water prior to usage.

While collecting samples contamination of the sample was avoided with any foreign material. Collected samples were brought to laboratory and stored to the refrigerator at 4°C temperature. Selected physicochemical parameters such as temperature, pH, conductivity, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen demand (COD), Oil and Grease content, chlorides and nitrates in the water were analyzed according to APHA (1995) and Trivedi and Goel (1986).

RESULTS AND DISCUSSIONS

Temperature

Temperature is basically important for its effect on chemical reactions, reaction rate, aquatic life and

the suitability of water for beneficial uses. The temperature values observed were 30 °C at S1 and S4 while at S2 was 31 °C and S3 was 28 °C. Temperature of waste water is commonly high because of addition of warm water from industrial activities. Increase temperature can cause change in the species of fish that can existing in receiving body. The mean values were higher than the WHO (2003) standards. The results indicate that some reactions could be speeded up by the discharge of this wastewater into stream. It will also reduce solubility of oxygen and amplified odour due to anaerobic reaction (Akan *et al.*, 2008).

Table 1: Physicochemical analysis of effluent samples at Mirkarwada and Mandvi sites.

Sr.No.	Parameters	S1	S2	S3	S4	Mean
1	Temperature (°C)	30	31	28	30	29.75
2	pH	7.15	6.75	6.8	7.22	6.98
3	Conductivity (mhs)	13.42	18.02	15.2	16.22	15.72
4	Chloride (mg/L)	7100	18602	1000	6700	8351
5	Total Solids(mg/L)	9990	15600	8400	8544	10634
6	Total Dissolved Solids(mg/L)	8200	14700	8200	12000	10775
7	Total Suspended Solids(mg/L)	1700	900	200	700	875
8	Chemical Oxygen demand(mg/L)	1200	2000	1900	2200	1825
9	Oil and Grease(mg/L)	1000	800	5600	3300	2675
10	Biological Oxygen Demand(mg/L)	10	90	115	266	120
11	Nitrate(mg/L)	168	126	140	166	150

S1-Site1, S2-Site2, S3-Site3, S4-Site4

pH

pH is the measurement of intensity of acidity and alkalinity and measures the concentration of hydrogen ion in water. The pH determination is important objective in treatment of waste. Variation in pH values of effluent can affect the rate of biological reactions and survival of various microorganisms. Higher pH values were recorded at S4. However these values are in permissible limit. Thorat & Wagh (1999) observed the pH of the effluent sample as 8.4. Rao *et al.* (1993) observed the pH of the textile industry effluent varied from 11.0 to 8.0. Kolhe *et al.* (2008) recorded the pH of Sugar industry untreated effluent as 6.5. High or low pH values in water have been reported to affect aquatic life and alter toxicity of other pollutant in one form or the other (DWAF, 1996).

Conductivity

The electric conductivity of water is a measure of the ability of a solution to conduct an electric current. The conductivity values were 13.42 mhs for S1; 18.02 mhs for S2; 15.20 mhs for S3 and 16.22 mhs for S4. The conductivity of the water is one of the important parameter used to determine the suitability of water for irrigation. It is useful indicator for salinity or total salt content of waste water.

Chlorides

Fish processing industries uses salt for preservation of food products; hence the content of chloride increased in discharged water. The average value of chloride was 8350 mg/L, which is higher than limit prescribed by WHO (2003).

The maximum value chloride was recorded at S2 (18602 mg/L) and minimum at S3 (1000 mg/L). Kolhe and Pawar (2011) observed chloride of untreated effluent in dairy industry as 630 mg/L. Effluent from sugar mill showed 205 mg/L chloride content (Kolhe *et al.*, 2008).

Total solids (TS)

Waste water contains variety of solid materials. Total solid are determined as a residue left after evaporation of unfiltered samples. The value ranges from 8400 to 15600 mg/L. The average value was 10634 mg/L. values of all the sites beyond the permissible limit of WHO (2003). Kolhe and Pawar (2011) found total solid 1310 mg/L in effluent in dairy industry.

Total dissolved solids (TDS)

The solid contained in the filtrate that passes through a filter with a normal pore size of 2 micrometer or less are classified as dissolved solids. Waste water contains high fraction of dissolved solids. The size of colloidal particles in waste water is typically in the range from 0.01 to 1.0 micrometer. The average value of TDS was 10775 mg/L which is beyond the permissible values. Hosetti *et al.* (1994) reported that total dissolved solids in range 488 ppm in the waste water. Rao, *et al.*, (1993) studied textile industrial effluent and recorded total dissolved solid value ranges from 8500 mg/L to 10,000 mg/L.

Total suspended solids (TSS)

Total suspended solids play an important role in waste water treatment. TSS test results are routinely to assess the performance of conventional treatment processes and need for effluent filtration in reuse application. TSS are the samples under suspension and remains in water sample. In present study the average value was 875 mg/L. Avsan & Rao (2001) observed the T.S.S. & sugar mill effluents as 220 to 790 mg/L.

Chemical Oxygen demand (COD)

It is the amount of oxygen required by organic matter for its oxidation by strong COD substance in water. The COD is a test which is used to measure pollution of domestic and industrial waste. The waste is measure in terms of equality of oxygen required for oxidation of organic matter to produce CO₂ and water. In present study the average value of COD was 1825 mg/L which is beyond the permissible limit of WHO (2003). Kolhe

et al. (2008) found value of COD 1230 mg/L in industrial effluent.

Biological oxygen demand (BOD)

It measure the amount of oxygen requires by bacteria for breaking down to simpler substances the decomposable organic matter present in any water, wastewater or treated effluent. It is also taken as a measure of the concentration of organic matter present in any water. The greater the decomposable matter present, the greater the oxygen demand and the greater the BOD values (Ademoroti, 1996). The present study effluent shows BOD value as 120 mg/L. Trivedi *et al.* (1986) observed the effluents of textile industry in the range from 320 mg/L to 720 mg/L. Low value of BOD is may be due to lesser quantity of total solids, suspended solids in water as well as to the quantitative number of microbial population (Avasan & Rao, 2001).

Oil and Grease

Oil and grease if present in excess amount it interfere with aerobic and anaerobic biological process. The all samples contain high quantity of oil and grease which causes serious problems. The average value of oil and grease was 2675 mg/L which is higher than the recommendations of WHO (2003). Akan *et al.* (2008) showed comparatively less value as 680mg/L in untreated effluent. Trivedi *et al.*, (1986) reported oil and grease in textile industry effluent varies from 230 to 1897 mg/L.

Nitrate

High nitrate concentrations are frequently encountered in treated wastewater, as a result of ammonium nitrogen. The average value of nitrates in effluents was 150 mg/L. High nitrate levels in wastewater could also contribute to eutrophication effects, particularly in freshwater (OECD, 1982).

Many workers have been reported to have potential health risk from nitrate in drinking water above threshold of 45 mg/l, which may give rise to a condition known as methaemoglobinemia in infants and pregnant women (Speijer, 1996).

While comparing each other Site S3 was found more polluted than other sites. Wastewater discharge from sewage and industries are major component of water pollution, contributing to oxygen demand and nutrient loading of the water bodies, promoting toxic algal blooms and leading to a destabilized aquatic ecosystem

(Morrison *et al*, 2001; DWAf and WRC, 1995). The waste discharged from fish processing industries is degradable waste, though it is hazardous to microorganism in the costal water. The extent of pollution was high as expressed by physicochemical properties. Analysis of industrial effluent discharge showed that the various parameters are beyond the permissible limit. The effluent from two industries shows acidic pH while remaining samples have alkaline pH. These values are generally due to the decomposition of the proteinaceous matter and emission of ammonia

compounds. The chloride content of industry S3 is within the permissible limit while other shows higher content. To reduce chloride content ion exchange, soda ash processes are essential.

The presence of oil and grease in an effluent was mainly due to the processing operations. It should be removed since they usually float and affect the oxygen transfer to the water and also objectionable from an aesthetic point of view. Overall findings indicated that effluent discharge of fish processing industries in Ratnagiri is highly polluted and remedial steps should be taken for avoiding water pollution.

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