QUANTITATIVE AND QUALITATIVE APPRAISAL OF WASTE WATERS OF FISHMEAL PLANT FOR FURTHER TREATMENT

P. Karthiyayini, Baskaran Manimaran* and D. Sukumar

Department of Fisheries Environment
Fisheries College and Research Institute
Thoothukudi-628 008, Tamilnadu
**Email: bas_mani@yahoo.com*

It was estimated that two tonnes of high organic strength wastewaters are generated per ton of fish meal produced. In this present investigation, strength of these waste waters was assessed for six months based on various physico-chemical characteristics. Among solids, total suspended solids (TSS) and total volatile suspended solids contributed to the mean value of 44,166.67 ppm and 42,983.33 ppm, respectively. The maximum BOD and COD recorded were 32,600 ppm and 57,600 ppm, respectively. Dissolved organic carbon was the dominating chemical species of carbon and recorded a mean value of 1,61,034 ppm. In the case of nitrogen, total organic nitrogen and ammonia recorded the mean value of 13,396 ppm and 678.8 ppm, respectively. The maximum concentration recorded in total phosphorus was 456ppm.

Keywords: Waste water, fishmeal, effluents, qualitative, quantitative appraisal

The fishmeal and oil industry is of global importance to livestock production, fish farming and human health. These two fishery products are of the most internationally traded fish based commodities in the world. Fishmeal and oil are manufactured from industrial or feed grade fish, which are mainly small, bony and oily fish and therefore not attractive for human consumption. The world's catch of fish crustaceans and mollusks roughly equals to 101 million tonnes, of which 30% is contributed by feed grade fish, which are processed into fishmeal and oil. Annual production of fishmeal is in the range of 6-7 million tonnes and a little under 1 million tonnes in the case of fish oil. This requires annual catch of 25 – 30 million tonnes of feed grade fish and fish offal. The fishmeal industry of India is largely export oriented and almost the entire quantity of the fishmeal is exported to various countries. In the production of fishmeal and oil, deoiling and dewatering are the two major process involved. In this process, approximately 2 tonnes of wastewater are generated per ton of fishmeal produced (Veiga *et al.*, 1994). Fishmeal plant wastewaters are classified under high organic strength wastewaters similar to that of other food processing industries. If such wastewaters are not properly treated, they would form an ideal breeding and feeding ground for rodents, flies and other insects posing environmental problems and health hazards. These high strength organic wastewaters could devastate the biodiversity when it reaches the natural aquatic ecosystem. Disposal of wastewaters generated in the fishmeal industry has always been a problem for fishmeal producers. Such wastewaters need to be treated properly before their disposal. Lack of proper treatment methodologies made the fishmeal producers to face environmental problems. Hence, the present study was proposed to study the physico-chemical characteristics of wastewaters emanating from fishmeal plant so as to assess the pollution potential of these wastewaters.

Materials and Methods

The wastewater samples required for the present investigation were collected from M/s. VKS Exports Fishmeal plant located at Sawyerpuram near Thoothukudi. In fishmeal plant, chemical methods are selected for wastewaters treatments based on the conditions of operation and characteristics of wastewaters (Aspe and Roeckel, 1990). Further, characteristics of the wastewater also vary depending upon the raw materials used for fish meal preparation. Hence, a thorough examination of changes in the physico-chemical characteristics of these wastewaters was studied for six months from September 2005 to February 2006, which is supposed to be the peak season for fish meal production. Monthly samples were collected and analyzed for various physico-chemical characteristics such as temperature, Electrical conductivity (EC), pH, Total dissolved solids (TDS), Total suspended solids (TSS), Total volatile suspended solids (TVSS), Biochemical

Table 1. Physico-chemical characteristics of fishmeal plant's wastewaters before deoiling

Sl. No.	Parameter	Values
1.	Temperature (°c)	28
2.	EC (mS)	81.5
3.	pH	7.1
4.	Total dissolved solids (ppm)	33780
5.	Total suspended solids (ppm)	222000
6.	Total volatile suspended solids (ppm)	200000
7.	Biochemical Oxygen Demand (ppm)	35760
8.	Chemical Oxygen Demand (ppm)	58203
9.	Total soluble carbon (ppm)	201340
10.	Dissolved inorganic carbon (ppm)	10790
11.	Dissolved organic carbon (ppm)	190550
12.	Ammonia (ppm)	820
13.	Nitrite (ppm)	248
14.	Nitrate (ppm)	23
15.	Total organic nitrogen (ppm)	14650
16.	Total nitrogen (ppm)	15541
17.	Soluble inorganic phosphorus (ppm)	410
18.	Total soluble phosphorus (ppm)	460
19.	Total phosphorus (ppm)	490
20.	Chloride (ppm)	14230
21.	Sulphate (ppm)	16540
22.	Oil and grease (ml/l)	432

Oxygen Demand (BOD), Chemical Oxygen Demand (COD), chemical species of carbon, nitrogen, phosphorus, chlorides, sulphates and oil and grease. In fishmeal production plant, two types of wastewaters are normally generated. They are, one before deoiling and another after deoiling. Usually, the wastewaters collected after deoiling is put into wastewater treatment. In this present investigation, both the above mentioned wastewaters were analyzed for six months, as it is to be used further in chemical and biological treatments. All the physico-chemical characteristics mentioned above were analyzed following the standard methods of APHA (1995).

Results and Discussion

Different physico–chemical characteristics of fishmeal plant wastewaters collected before and after deoiling from the fishmeal plant are furnished in Tables 1 and 2. The fishmeal plant selected in our study discharges on an average of 30,000 litres of wastewaters per day. Various physico-chemical parameters such as EC, pH, solids, organic and inorganic carbon, oxygen demand, different chemical species of nutrients, N and P, chloride and sulphates were analysed and their mean values are furnished.

Depending on the raw material and the process used to produce fishmeal, different types of wastewater are generated (Veiga *et al.*, 1994). The type of feed material and process also reflects on the quantity of wastewaters generated. Hence, there is every possibility of variation in quality and quantity of wastewaters from one fishmeal plant to another. In our study, the wastewaters were collected from the M/S VKS Exports fishmeal plant. In this factory, during fishmeal preparation, the raw material undergoes a process of cooking with steam, trituration and compression, generating a stream of wastewaters that after extracting the oil produces the residual effluent. The wastewaters collected before deoiling contained 43.2% of oil, 22.2% of suspended solids and 34.6% of liquid and after deoiling, these wastewaters contained only 4.4% of TSS and devoid of oil. This fishmeal plant discharged on an average 30000 litres of wastewaters per day. It was also estimated that approximately two tonnes of wastewaters are generated per ton of fish meal produced. In our study more importance was given to the oxygen demand and dissolved fractions of nutrients because the process of cooking with steam, trituration and compression emanate more amount of dissolved fractions in the effluents. The mean level of 52448 ppm of COD documented inour study could be equated to the COD of a primarily treated spent wash (Sundaramoorthy *et al.*,2003) and wastewaters from fish canneries (Mosquera-Corral *et al.*, 2003; Garcia-Sanda *et al.*, 2003). Few workers evaluated the wastewater characteristics of fishmeal plant and reported a COD range of 30,000-90,000 ppm. (Otwell, 1990; Gonzalez, 1995; Aspe *et al.*, 1997; Garrido *et al.*, 1998) The mean total nitrogen level recorded in our study was 14,000 ppm which is higher than that of wastewaters from fish processing industries. The maximum total nitrogen concentration of 3,200 ppm was reported only in the case of fish canning industries (Garcia-Sanda *et al.*, 2003). Veiga *et al.* (1994) reported a soluble inorganic phosphorus level of 300 ppm in the wastewaters of fishmeal plant. Similar results were also observed in the present investigation.

Table 2. Physico-chemical characteristics of fishmeal plant's wastewaters after deoiling

Sl. No.	Parameters	Months						Mean
		Sep	Oct	Nov	Dec	Jan	Feb	
1.	Temperature (°c)	27.4	28	27.2	28	26.5	26.4	27.25
2.	EC (mS)	78.52	79.52	76.52	75.6	78	78.7	77.81
3.	pH	6.9	6.5	6.45	6.56	6.35	6.7	6.58
4.	Total dissolved solids (ppm)	30100	31200	30200	30800	31000	30600	30650
5.	Total suspended solids (ppm)	41200	58400	40000	40400	40000	45000	44166.67
6.	Total volatile suspended solids (ppm)	40600	568000	39200	39600	39200	42500	42983.33
7.	Biochemical Oxygen Demand (ppm)	32000	30500	33000	32600	32000	31500	31933
8.	Chemical Oxygen Demand (ppm)	52800	48000	57600	53840	52800	49650	52448.33
9.	Total soluble carbon (ppm)	188070	195505	128270	161440	185653	145270	167368
10.	Dissolved inorganic carbon (ppm)	4549	6275	8270	5230	6423	7257	6334
11.	Dissolved organic carbon (ppm)	183521	189230	120000	156210	179230	138013	161034
12.	Ammonia (ppm)	570	580	650	870	770	630	678.83
13.	Nitrite (ppm)	nil	17	nil	3	14	8	7.0
14.	Nitrate (ppm)	6	24	21	29	25	13	19.67
15.	Total organic nitrogen (ppm)	13424	11559	14469	14246	13991	12687	13396
16.	Total nitrogen (ppm)	14000	12180	15140	15148	14200	13338	14001
17.	Soluble inorganic phosphorus (ppm)	290	340	140	380	340	320	301.67
18.	Total soluble phosphorus (ppm)	340	360	350	440	360	380	371.67
19.	Total phosphorus (ppm)	380	460	431	456	453	430	435
20.	Chloride (ppm)	13360	13380	125609	11520	112440	12860	12686.67
21.	Sulphate (ppm)	15240	13030	14480	14470	14880	13270	14228.33

References

APHA, 1995. Standard methods for the examination of water and wastewater, 19th Edn., American Public Health Association, NewYork, p.1100

Aspe, E., Marti, M.C. and Roeckel, M., 1997. Anaerobic treatment of fishery wastewater using a marine sediment inoculum. *Wat. Res.*,31:2147-2160

Garcia–Sanda, E., Francisco, O. and Lema, J.M., 2003. Clean production in fish canning industries: Recovery and reuse of selected wastes. *Clean Tech. Environ. Policy,* **5**: 289–294

Garrido, J.M., Guerrero, L., Mendez, R. and Lema, J.M., 1998. Nitrification of wastewaters from fishmeal factories. *Wat. Sci.*, **24**:245-249

Gonzalez, J.F., 1995. Wastewater treatment in the fishery industry. *FAO Fisheries Technical Paper* **355**, FAO, Rome, p.52

Mosquera–Corral, A., Campos, J.L., Sanchez, M., Mendez, R. and Lema, J.M., 2003. Combined system for biological removal of nitrogen and carbon from a fish cannery wastewater. *J. Envt. Engg.*, **29**:826–833

Otwell, S.W., 1990. Waste treatment and utilization. **In**: Seafood industry (Flick, G.J. and Martin, R. E., Eds.). Von Nostrand Reinboey, NewYork, p.445

Sundaramoorthy, K., Thiyagarajan, T.M., Valliappan, K. and Singaram, P., 2003. Utilization of distillery spentwash in agriculture. **In**: Proceedings of the International Symposium on Transitions in Agriculture for Enhancing Water Productivity, pp.205–222

Veiga, M.C., Mendez, R. and Lema, J.M., 1994. Wastewater treatment for fisheries operations. **In**: Fisheries processing: biotechnological applications (Martin, A. M., Ed.). Chapman and Hall, London, pp.345-370