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ASSESSMENT OF THE TOXICITY OF WASTE WATER FROM A TEXTILE DYEING INDUSTRY IN BHIWANDI DIST: THANE (MAHARASHTRA) TO FRESH WATER TELEOST *OREOCHROMIS MOSSAMBICUS*

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ABSTRACT

The present investigation was carried out to study the toxicological effects of effluents discharged from the textile-dyeing industry from Bhiwandi city in fresh water fish *Oreochromis mossambicus*. Static, short-term, acute toxicity tests were performed over a period of 96 hours. The LC50 values at the end of 24, 48 72 and 96 hours were calculated. Efficiency of ETP as well as Safe concentration of the treated effluent were also calculated. The total efficiency of the treatment process was 71.42% and the safe concentration of the treated effluent is 17.85%. These data are highly useful in establishing limits of acceptability by the aquatic animals.

INTRODUCTION

Industrial effluents are possibly the most important single source of Contaminents to aquatic environment. (Bryan and Langston, 1992). Some toxicants contained in the industrial effluents have been reported to be toxic, depending on the dose and exposure duration. (Yusuff and Sonibare, 2004), and they can import serious damage to aquatic life. (Vinodhini *et al.*, 2009). There have been several reported cases of fish mortality due to the discharge of industrial effluents from several industries into the receiving water bodies (Das; 2003; Adewoye and Lateef, 2004; Adewoye *et al.*, 2005).

Textile industries are the major sources of pollution due to the nature of their operations, which require high volume of water that eventually results in higher wastewater generation. (Nemerow, 1978). Uptake of textile effluents through food chain in aquatic organisms may cause various physiological disorders.

Physico– chemical parameters are generally used for evaluation of effluent quality. However, these parameters alone cannot give a quantitative measure of the impact of pollution. Toxicity evaluation is an important and cost-effective tool in waste water quality monitoring as it provides the complete response to the test organisms to all the compounds in a cumulative way (Somashekhar *et al.* 1985; Tisler & Koncan, 1999) and more useful in regulating toxic chemicals and also determine the long and short term impacts of discharge on aquatic life of the receiving body of water and ground water level (Kohn, 1980). Also, the studies are highly useful for determining the

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safe concentrations of waste water to be discharged into aquatic water bodies (Bombanuel *et al.* 2006). This in turn, could pave way to establish limits and levels of their acceptability by the living organisms. Therefore, the ultimate aim of toxicity evaluation is to predict the acceptable levels of toxicants in the environment to the biota. To understand Whole Effluent Toxicity (WET) using fish, toxicity test end point tool used in compliance monitoring is called toxic units. The tests end points are converted to a number and a measure of toxicity in an effluent is determined by the acute toxic unit (TUa). It is a reciprocal of the effective concentration and indicates higher TUa, greater toxicity. It is helpful to translate concentration based toxicity data into units (USEPA 2000). In the acute toxicity of contaminants in static bioassays, the use of 96 hour, LC50 has been widely recommended as a preliminary step in toxicological studies on fishes.

Some of the prominent workers who have worked on toxicity are Roopadevi and Somashekar (2011); Yadav*et al.* (2007); Mishra*et al.* (2011); Daksh and Capoor, (2011); Muley and Karanikar (2004); Mc Leese, (1974); Karthikeyan*et al.* (2006); Amte & Mhaskar (2012) studies on textile-dyeing waste- waters from Bhiwandi city, Dist: Thane, Maharashtra, India (In press).

The objective of the present study was to evaluate the acute toxicity of effluents (Untreated and treated) from a textile dyeing industry situated in Bhiwandi (Dist: Thane, Maharashtra) exposed to various concentrations on a fresh water teleost *Oreochromis mossambicus*.

MATERIALS AND METHODS

Source of fish and media

Healthy fishes irrespective of sex were collected from the nearby water reservoir and transported to the laboratory using standard procedure. Fishes were acclimated to laboratory conditions in well aerated, aged tap water for 14 days. The water was changed every 24 hours. Fishes were fed on artificial food during the study period. Feeding was stopped prior to 24 hours before the commencement of the experiment. Diseased fish or fish showing any abnormal behavior were removed from the aquarium. Only healthy animals (average length 12-14cm; average wt 35-50g) were selected for the experiment.

The effluent was collected from a textile dyeing industry in Bhiwandi (Dist-Thane, Maharashtra). The effluent was collected at a fixed point where the discharges from all the stages of processing are released into the effluent treatment plant (referred as untreated effluent hereafter). Similarly, the effluent was collected after the treatment process (hereafter referred as treated effluent). The effluents were collected in a sterile polythene container and store in refrigerator.

Bioassays

Desired concentrations of the effluents were obtained by diluting the effluent with aged tap water. Initially preliminary screening test was carried out to ascertain the range of toxicity of the effluent sample before the actual bioassay. Acute static toxicity tests were performed in accordance with APHA (2005). For the determination of LC_{50} various concentrations of both the effluents (untreated and treated) were prepared using aged tap water. The tests were conducted in triplicates. The concentrations of the untreated effluent used were 0.01, 0.1, 0.18, 0.32, 0.56 and 1%. Since it was found to be much toxic than treated effluent as confirmed by preliminary test. The concentrations of the treated effluent used were 1, 10, 18, 32, 56 and 100%. Separate controls were maintained. The mortality rate was recorded at 24, 48, 72 and 96 hours exposure to the effluent (both untreated & treated). The percentage for corrected mortality was calculated using Abbott's formula.

The correct mortality data was analyzed to determine the LC_{50} values. The values were obtained by probit regression line, taking test concentrations and corresponding % mortalities on log value & probit scales respectively. By graphical interpolation LC_{50} values were fixed and their fuducial limits 95% upper and lower confidence limits were also determined (Litchfield–Wilcoxson, 1949).

Statistical analysis

LC_{50} and their corresponding 95% confidence intervals were calculated by probit analysis. Safe concentration was obtained by multiplying the lethal concentration values with an application factor of 0.1 (Bobmanual *et al.*, 2006). Acute toxic unit (TUa) and total efficiency of effluent treatment unit was calculated (USEPA, 2000) as follows:

$$TUa = \frac{100}{LC_{50}} \ \%(V/V)$$

$$E = \frac{(TUai - TU\alpha e)}{TUai = \quad \%(V/V)} \times 100$$

Where, TUai = untreated effluent
Tuae = Treated effluent
E = Efficiency

RESULT AND DISCUSSIONS

There were not many variations in the physical and chemical characteristics of dilution water used for the experiments. When the test samples were administered to experimental tanks, various stressful behaviors like erratic swimming, increased activity, inconsistent jumping were observed in *Oreochromis mossambicus* exposed to both untreated and treated effluent. These behavioral responses of fish are in response to toxicants present in the sample at different duration of exposure and the prevailing specific environmental conditions as opined by Bobmanuel *et al*., (2006). This also signifies respiratory impairment, an outcome of the impact of the waste water on the gills of fish as observed by Adewoye *et al*., (2005). There was gradual loss of equilibrium and eventually 100% mortality at 96 hr occurred at higher concentrations Viz., 1% and 100% of untreated and treated effluent respectively.

The responses recorded for the fish in this study are similar to those reported by Danielly de paiva magalhoes *et al*., (2007) and Chukwuand and Okhumale (2009). Such an anomaly was not observed in the control set maintained under identical experimental condition.

The results of mortality analysis of the untreated effluents against Oreochromis mossambicus yielded the derived toxicity indices values (LC_{50}) ranging from 0.9% at 24 hr to 0.16% at 96 hr, while for the treated effluent, the values ranged between 46% at 24 hr to 0.56% at 96 hr (Table 1). The lethal concentrations (LC50) were inversely proportional to duration of exposure. The mortality rate of *Oreochromis mossambicus* remained directly proportional to duration of exposure, concentration and toxicity factor as observed in catfish hybrid by Gabriel and Okey (2009) and TUa (Pool *et al*., 2009). The acute toxicity units (Pool *et al*., 2009) obtained for untreated effluent were higher than treated effluent, thus showing that untreated effluent is more toxic to *Oreochromis mossambicus* as compared to treated effluent.

The total efficiency of the treatment was 71.42% the safe dischargeable concentration of the effluent was set to be 0.016% for untreated effluent and for treated effluent 17.85% which is highly useful in establishing limits of acceptability by the aquatic animals. It is observed that the treated effluent impact toxicity in fresh water teleost *Oreochromis mossambicus* and therefore the present level of treatment of effluent prior to discharge appears insufficient.

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Table 1. Relative acute toxicity of Untreated and Treated effluent of textile-dyeing industry on *Oreochromis mossambicus*

Exposure duration (Hr)	LC_{50} (%)	TUa (Acute toxicity unit)	Safe concentration (%)	Total efficiency (%)
		Untreated Effluent		
24	0.9	111.11	0.09	-
48	0.4	250	0.04	-
72	0.4	250	0.04	-
96	0.16	625	0.016	-
		Treated Effluent		
24	46	2.17	0.21	98.04
48	44	2.27	0.22	99.09
72	1	100	10	60
96	0.56	178.57	17.85	71.42

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