Toxicity Testing of Industrial Effluent Using *Ceriodaphnia Dubia*

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Abstract

The plankton population represent the indices of health and productivity of an aquatic ecosystem. They constitute the base of aquatic food chain since most of the macrofauna thrive on plankton for their food requirements. Zooplankton are highly sensitive to pollution stress and many species of protozoa, rotifera and cladocera are biological indicators of water quality in river and lakes receiving toxic and organic wastewaters. The zooplanktonic organisms are significant links in aquatic food chain and play a major role in ecology as the aquatic biotic population of fish thrives on them.

From findings reported in literature it is evident that studies on freshwater zooplankton are limited to certain specific types of chemicals and studies on impact of industrial wasterwaters are very scanty. So keeping this in mind toxicity testing was done on freshwater zooplankton *Ceriodaphniadubia* using neutralized pickling wastewater of a steel processing industry. LC50, LC100 and No Observed Effect Concentration (NOEC) were determined in static bioassay test.

KEYWORDS: Toxicity testing, Industrial effluents, Zooplankton, Pickling Wastewater, Bioassay Test.

INTRODUCTION

In nature toxicants seldom enter the aquatic environment as pure chemicals. Animals and plant communities are exposed to the hazards of industrial wastewaters or surface run offs containing a complex mixture of several chemicals and toxicants. It is therefore imperative to determine the toxic threshold of the industrial effluents for establishing their safe limits and also to establish the tolerance limits to test species. The information and data base is useful for deriving water quality criteria for aquatic organisms.

Zoooplankton toxicity testing to assess the adverse effects of industrial wastewaters are reported in literature. Winner and Farrell (1976) evaluated the sensitivity of Daphnia magna, D.Pulex, D.Parvula and D.Ambigua exposed to acute and chronic copper stresses under laboratory conditions. Mani and Konar (19840 studied the acute toxicity of malathion an organophosphate insecticide to Diptomusforbest. Sweet and Meier (1997) studied the lethal and sublethal effects of azulene and longifolene to D.magna and Ceriodaphniadubia. Rupareliaet al (1995) studied the toxicity of Cypermethrin to Daphnia magna. Onuoha et al (1996) studied the comparative toxicity of heavy metal cadmium to copepods and Ostracods.

From findings reported in literature it is evident that studies on freshwater zooplankton are limited to certain specific types of chemicals and studies on impact of industrial

wastewaters are very scanty. After analyzing this situation it is decided to study the tocxicity of a industrial effluent (pickling wastewater0 of a steel processing industry producing galanazied tin sheets to the freshwater zooplankton *Ceriodaphniadubia*.

MATERIALS AND METHODS

Different species of zooplankton serve as test organisms for predictive ecotoxicological work. In the present work freshwater zooplankton *Ceriodaphniadubia* was selected as test species. It belongs to order cladocera.

The freshwater zooplankton *Ceriodaphniadubia* was collected from Ambazari lake of Nagpur city and was separated in the Environmental Biotechnology laboratory of NEERI, Nagpur. For obtaining uniform population growth of test species mass culturing of *Ceriodaphniadubia* was done according to methods prescribed in literature (De Kruijf et al , 1988; UNEP 19920. The zooplanktonic organisms were separated from the the flasks and used for toxicity testing.

The industry selected for toxicological study is one of the major inland steel processing unit in Vidarbha region which manufactures cold rolled steel sheets in wide range of thickness, galvanized sheets, colour sheets, and coated sheets. In its processing pickling wastewater is generated which is highly acidic in nature. For toxicity evaluation the combined acidic wastewater and rinse waster before liming was taken as raw wastewater. Liming was done in laboratory at PH 7.00 and the sludge was taken as neutralized wastewater of pickling process. Its characterization was done in laboratory and used for toxicity testing bioassay experiments (APHA, 1989).

For performing bioassay experiments 250 ml. glass beakers were used with 100 ml. test solution containing 10 organisms per beaker. The serial dilutions of the wastewater were prepared. The toxicity tests were undertaken with 3 replicates each for control and experimental dilutions. Ten nos. of 48 hrs.old newly hatched organisms of the respective test species were randomly distributed to each of the test container and the mortality was observed at 12 hrs interval. Death was ascertained when the organisms failed to respond to very gentle prooding and there was no movement.

RESULT AND DISCUSSION

The characterization of neutralized pickling wastewater was presented in table 1. The response of *Ceriodaphniadubia* is shown in table 2. The observations were recorded with respect to lethal (LC100), 50% mortality (LC50) and NO Observed Effect Concentration (NOEC). LC100 and LC50 values were directly recorded from experiments, while LC50 values were calculated by Probit Analysis. The LC50 value in case of neutralized pickling wastewater was observed at 3.55 dilution which come to be 3.48% as derived from probit Analysis (Finney 1971). The NOEC was observed at 2% dilution for *Ceriodaphniadubia*.

Zooplankton community are ecologically significant since they form the critically important intermediate trophic level between phytoplankton and fish in aquatic ecosystem. The popularity of Ceriodaphniadubia and Daphnia magna as test species in ecotoxocological studies is well documented in literature pertaining to the subject

(Persoone and Janeesen, 1993; Onuoha et al 1996). They are also amenable for studies on bioaccumulation of persistent toxicants in the environment (Evans, 1988). The main objective behind these testsis to determine the toxic threshold limits for zooplankton for effective conservation and protection of this community in receiving waters. Most of the toxicological studies have focused on the acute toxic effects and such studies provide insight into the relative toxicity of varius compounds, differential sensitivity among species and factors affecting species sensitivity (Biesinger and Christensen, 1972;

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Table 1 : Characteristics of Neutralized Pickling Wastewater

Parameter	***Value ****
PHYSICO-CHEMICAL CHARACTERISTICS	
Colour	Pale Green
PH	7.00
Conductivity (us/cm)	684.80
Acidity	180
Chlorides	75,000
Total Suspended Solids (TSS)	560
Total Dissolved Solids (TDS)	78000
Oil and Grease	N.D.
HEAVY METALS	
Iron	55000
Zinc	2.82
Cadmium	7.5
Chromium	0.66
Nickel	8.24
Manganese	178
Lead	10.44
Aluminium	55.00
Copper	1.20
Silicon	45.20

All the values are in mg/litre except colour, PH, Conductivity
* Average of 3 values are taken.

Table 2
Response of Ceriodaphniadubia to neutralized pickling wastewater

Wastewater Conc. (%v/v)	**No. of Zooplankton Tested**	**% Mortality in hours**			
		12	**24**	**36**	**48**
2.0	10	-	-	-	-
2.5	10	-	-	-	10
3.0	10	-	-	10	20
3.5	10	-	10	30	50
4.0	10	10	20	50	70
4.5	10	20	30	70	90
5.0	10	30	50	90	100
5.5	10	40	60	100	100
6.0	10	50	80	100	100
6.5	10	80	100	100	100
7.0	10	100	100	100	100