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Some Preliminary Observations on the Toxicity of Rayon Factory Effluents on Aquatic Fauna

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Abstract : The aquatic fauna, Fish, Unio, Crab and Snail were exposed to various concentrations of Rayon Factory Effluents at different time intervals with a view to check the percentage of mortality which is induced by the effluents. Among the aquatic fauna used for toxicity evaluation it is observed that the Unio are more susceptible followed by Snail, Crab and Fish which have almost equal tolerance. By the observations made in the present study suggest that the Rayon Factory Effluents are toxic, therefore these effluents should not be released directly out side with out treatment

Key words : Aquatic fauna, Rayon factory, Effluents, Toxicity

Introduction

Toxicity studies play an important role with a view that the data generated from acute toxicity test has been increasingly used to develop qualitative structure-activity relations in an effort to predict the toxicity of pollutants from the physico-chemical properties. The toxicity of toxicants is influenced by environmental factors such as temperature, light, water, hardness and relative humidity. Since aquatic environment is the ultimate sink for all pollutants, aquatic toxicity tests have become an integral part of the process of environmental hazard evaluation of toxic chemicals. Generally the potential impact of pollutants is more on the aquatic organisms than the terrestrial environment. The toxicity studies are necessary in water pollution evaluation because chemical and physical losses are alone not sufficient to asses potential effects on aquatic biota. The effects of toxic substances are by and large on the biological system, therefore the use of bioassay methods on aquatic animals have gained increasing importance in determining the effects of pollution on aquatic life. In the present study to evaluate the effect of Rayon factory effluents on aquatic fauna such as Unio, Fish, Snail and Crab, the bioassays were conducted on various aquatic fauna after exposing them to various concentrations of Rayon factory effluents.

Material and Methods

For the present study the animals *viz*. the fish, snail, crab and unio were collected from freshwater bodies (tanks, ponds and lakes). Irrespective of sex and almost the animals of equal size and weight were brought to laboratory and they were maintained in large glass aquaria. All the animals used for toxicity experiments were acclimatized in the laboratory at least for 15 days before they were used in the experiments. After the normal process of acclimatization the animals were washed in 0.1% KMnO4 solution. All the animals were provided feed during the period of acclimatization. The glass aquaria containing the animals were aerated at regular intervals to prevent the hypoxic condition.

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For the treatment with Rayon Factory Effluents, in order to study their toxic effects on the animals four varieties of animals were choosed i.e., Fish (*Channa punctatus*), Unio (*Pyrreysia rugosa*), Crab (*Paratelphosa cinex*) and Snail (*Pila globossa*). To know the toxic effects of effluents, these animals were exposed to different concentrations of effluents with different time intervals. To dilute the effluents, the tap water is added for appropriate quantity. The concentration of effluents taken for the present study are 100% (pure effluents), 75% (added 25% water), 50% (added 50% water), and 25% (added 75% water). Thus the effluents are diluted with mixing the tap water to obtain the required concentration (Table-1). After determined the final concentrations the live and active animals that are already acclimatized in the laboratory have been used to study the mortality rate for 24 hours, 48 hours, 72 hours and 96 hours. In each concentrations of the sample, a uniform number of 20 animals were used and 20 glass troughs were kept at a time for each concentration. The mortality and behavioral changes in the animals after completion of 24 hours, 48 hours, 72 hours and 96 hours were recorded. The mortality rates were counted for each set of animals (Abbots, 1925) at the end of different time logs.

Table 1 : Concentration of Rayon effluents for toxicity Studies

Effluent (in liters)	Tap water (in liters)	Final Concentration of Effluents (%)
10	-	100
7.5	2.5	75
5	5	50
2.5	7.5	25

Results and Discussion

25% Effluent Concentration:

The aquatic fauna were exposed to 25% effluent concentration and at the end of 24 hrs, 48 hrs, 72 hrs and 96 hrs after 24 hours exposure no conspicuous behavioral changes were noticed. The unio and snail have shown rapid movements and after 48 hrs of exposure higher exhatibility and formation of mucus layer over the smooth body surfaces was noticed. However at 72 hrs of exposure in this concentration all the organisms have lost their movements gradually and became static. The organisms have also lost equilibrium and slowly they started floating over the water. The mortality rate observed at 25% effluent concentration in fish is 0%, 30%, 30% and 40%. During 24 hrs, 48 hrs, 72 hrs and 96 hrs respectively, the mortality rate of unio in this concentration is 10%, 40%, 50% and 0% and the mortality rate of crab is 0%, 40%, 50% and 10% and the mortality of snail is 10%, 40%, 40% and 10%.

50% Effluent Concentration:

After exposure of aquatic organisms to 50% effluent concentration the observations were made after completion 24 hrs, 48 hrs, 72 hrs and 96 hrs revealed that the fish, and crab have exhibited erratic swimming and jerky movements and the fish used to exhibit escaping refluxes which are increased with the increase of exposure time. The behaviors abnormalities noticed in the aquatic fauna were relatively increased initially and subsequently subsided and at last the animals became quit. The fish also struggled hard and often used to come out of the water and shared mild response to external stimuli. The percentage mortalities recorded in 50% effluent concentration were 0%, 40%, 50% and 10% in fish; 15%, 50%, 35% and 0% in unio; 20%, 40%, 40% and 0% in crab, and 10%, 50%, 40% and 0% in snail.

75% Effluent Concentration:

After exposure of aquatic organisms to 75% effluent concentration the observation

Table 2 : Mortality of animals exposed to various concentrations of Rayon Factory Effluents at different time intervals

Test animals	Quantity of animals	Effluent concentration (%)	Duration of Exposure			
			24 hrs	48 hrs	72 hrs	96 hrs
Fish (*Channa punctatus*)	20	100	5	13	2	-
		75	5	10	5	-
		50	-	8	10	2
		25	-	6	6	8
Unio (*Pyrreysia rugosa*)	20	100	8	10	2	-
		75	6	10	4	-
		50	3	10	7	-
		25	2	8	10	-
Crabs (*Paratelphosa cinex*)	20	100	5	8	7	-
		75	4	8	8	-
		50	4	8	8	-
		25	-	8	10	2
Snail (*Pila globosa*)	20	100	6	10	4	-
		75	4	10	6	-
		50	2	10	8	-
		25	2	8	8	2

made after completion 24 hrs to 96 hrs. It revealed that even before completion of 24 hrs exposures rapid movements were observed in all the four organisms. The abnormal behavior exhibited especially is the fish and crabs are higher exit ability, surfacing, gulping of hair, rapid movement and spiraling of animals at the bottom of troughs. At 48 hrs of exposure almost all the organisms became dull and mortality was observed, at 72 hrs of exposure the fish and other organisms floating over the water in the experimental troughs. The percentage mortalities observed in 75% effluent concentration at 24 to 96 hrs of exposure in fish are: 25%, 50%, 25% and 0% in unio are 30%, 50%, 20% and 0% in crab are 20%, 40%, 40% and 0% and in snail are 20%, 50%, 30% and 0%.

100% Effluent Concentration:

After exposure of aquatic organisms to 100% effluent concentration for 24 to 96 hrs it revealed that the organisms started hyper excitability and jerking movements and escaping refluxes even before 24 hrs of exposure they became shaggiest and coming to the surface. But some of them have dried and 48 hrs of exposure many of them have dried and the rest who were five were quit inactive. The percentage mortalities observed in fish, unio, crab and snail are 25%, 65%, 10% and 40%; 50%, 10%, 0% and 25%; 40%, 35%, 0% and 30%; 50%, 20%, 10% and 0%, respectively.

In the present investigation the Rayon Factory effluents induced mortality in Fish, Crab, Unio and Snail at different concentrations. Among the animals used for toxicity evaluation it is observed that the Unio

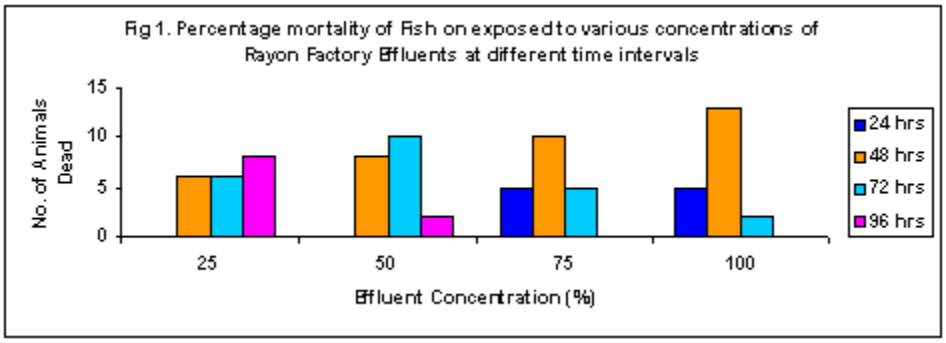
Fig 1. Percentage mortality of Fish on exposed to various concentrations of Rayon Factory Effluents at different time intervals
No. of Animals Dead
15
10
5
0
25
50
75
100
Effluent Concentration (%)
24 hrs
48 hrs
72 hrs
96 hrs

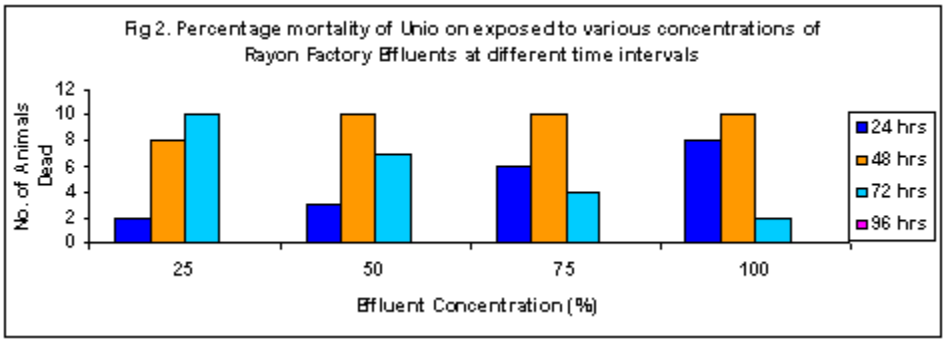
Fig 2. Percentage mortality of Unio on exposed to various concentrations of Rayon Factory Effluents at different time intervals
No. of Animals Dead
12
10
8
6
4
2
0
25
50
75
100
Effluent Concentration (%)
24 hrs
48 hrs
72 hrs
96 hrs

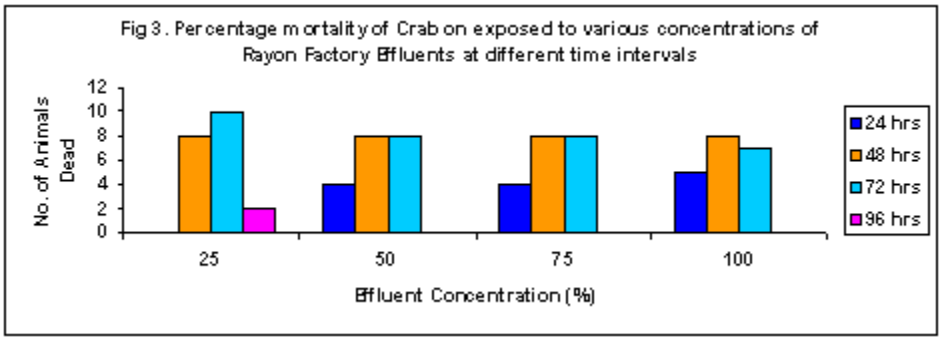
Fig 3. Percentage mortality of Crab on exposed to various concentrations of Rayon Factory Effluents at different time intervals
No. of Animals Dead
12
10
8
6
4
2
0
25
50
75
100
Effluent Concentration (%)
24 hrs
48 hrs
72 hrs
96 hrs

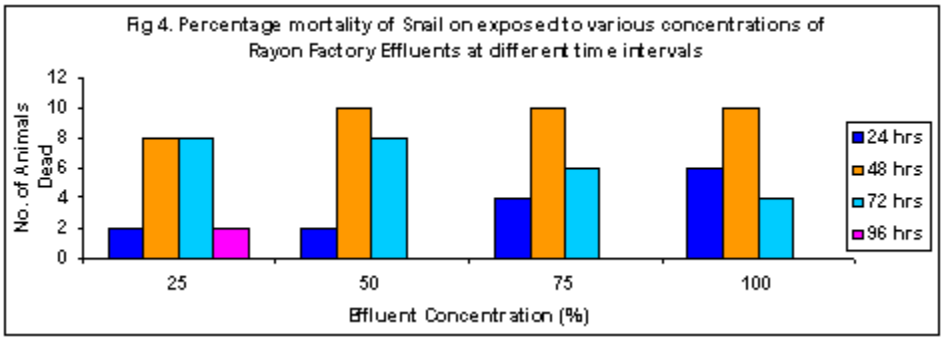
Fig 4. Percentage mortality of Snail on exposed to various concentrations of Rayon Factory Effluents at different time intervals
No. of Animals Dead
12
10
8
6
4
2
0
25
50
75
100
Effluent Concentration (%)
24 hrs
48 hrs
72 hrs
96 hrs

are more susceptible followed by Snail, Crab and Fish which have almost all equal tolerance. The tolerance of Fish and Crab may be the reason that, they engulf air through their mouth, which may be the adaptive behavior of these organisms to combat the toxic effects. It may be observed that at 25% concentration the survival rate of fish maximum duration, which is indicated by the 100% mortality rate at 96 hours of exposure. The maximum susceptibility is exhibited by Unio which is evidenced by 100% mortality at 72 hours of exposure.

The present investigation of toxicity studies of Rayon pulp effluents substantiates with earlier studies made on Fish, Copepods and other aquatic organisms (Dard Hunter, 1972). The mortality induced by the effluents might be not only due to chloro-lignin and other compounds such as naturally accruing acids, chlorinated resin acids, chlorinated phenolics, unsaturated fatty acids, trepans and on other hand certain non-specific acids present in the effluents might have induce toxicity in aquatic fauna and ultimately leads to their death (Schacher, 1979). Hence, the observations made in the present study may be concluded that the Rayon Factory effluents certainly toxic to the aquatic fauna and these effluents are not free of pollutants and these effluents appeared to cause the lethal effects on various aquatic fauna found in the surrounding water bodies and in course of time it may leads to considerable reduction of the aquatic population which include fish fauna. Therefore these effluents should not be released directly outside with out treatment it is suggested, because the treatment of effluents might reduce the toxic load.

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