

Bio assay on effectiveness of the chemical hydrolyzation for denaturing agrochemical contaminated wastewater

G.M.G.M.M Wickrama, R.M.G .N Rajapakshae and N.P.P Liyanage
Faculty of Animal Science and Export Agriculture, Uva Wellassa University of Sri Lanka

and

W.R.K Fonseka
Industrial Technology Institute, Colombo 07.

Introduction

Pesticides provide the primary means for controlling organisms that compete with man for food and fiber, livestock and crops. Global insecticide use in 2007 has been estimated 404 000 metric tons of active ingredient (Grube *et al.* 2011). The agricultural sector is the primary user of pesticides, consuming over four million tons of pesticides annually (Chen *et al.* 2009 and Chevillard *et al.* 2012). Most agrochemicals imperviousness to microbial degradation and has tendency to bio-accumulate in the soil fauna and flora. Water contamination has turned into a significant danger to the presence of living life forms in aquatic environment and aquatic organisms are highly susceptible for the agrochemical lethality. Many studies have shown the toxicity effect of agrochemical, but few studies have done to investigate the effectiveness of those treatment methods. Since the usage of agrochemical cannot be banded, best thing is finding a suitable method to detoxify them and understand the effectiveness of the particular method. Hydrolysis is a chemical reaction in which natural constituents respond with water and break into more diminutive (and less toxic) compounds. Fundamentally, hydrolysis is a destructive technology in which the original molecule forms two or more new molecules (EPA, 1993). Hydrolysis could be a viable treatment technology for agrochemical wastewater. In this study the effectiveness of the alkaline hydrolysis was estimated by using field data which were taken from the effluent treated plant (ETF) of agrochemical formulation and repacking industry, and also a bio assay was used to analyze the effect to the aquatic species from the treatment method.

Methodology

To check the effectiveness of “Alkaline Hydrolysis” method, samples were collected from a wastewater effluent treated plant in pesticide repacking and formulation industry. Samples were collected from raw water and treated tanks and measured Chemical Oxygen Demand (COD), Total Suspended Solid (TSS) and pesticide active ingredients (Glyphosate, MCPA, Profenofos). The samples were analyzed according to the American Public Health Association (APHA 2540 D, 2014) standard methods. All analysis were carried out at Environment Technology Section (ETS) and Chemical and Microbiological Laboratory (CML) section in Industrial Technology Institute (ITI). Those parameters were compared and checked the reduction efficiency. To check the effect to the aquatic ecosystems after applying the treatment “Guppy” (*Poicelia reticulatae*) were used for a bio assay. Behaviors and mortality rates were evaluated after introducing them to the treated effluent. One hundred fifty specimens of *P. reticulatae* with mean length of 2.5 ± 0.5 cm and mean weight 0.2 ± 0.5 were collected from the drainage canals with scoop nets and carried to the laboratory in a doubled polythene bags half filled with water from the source. They were kept in fifteen holding tanks (30X30X30 cm). One quarter 1/4 were filled with de chlorinated tap water and allowed to acclimatize to experimental environment condition: 30 °C, pH 7.8 for 1 week before applying treated effluent. Ten fish per tank were stocked (With active animals in each) Physico-chemical parameters such as DO, Temperature, pH of the test media were

measured before and during the experiment period using Horiba Water Quality Checker. Mortality assessment was carried out for 24 h to 96 h of intervals. Fishes were assumed to be dead when there was no body or opercula movement. Statistical data analysis was done in the MINITAB (version 16.0) statistical software package. All the data were analyzed statistically using one way ANOVA (analysis of variance) table to detect difference among locations ($p < 0.05$).

Results and Discussion

Results which were obtained by the field data, it shows “Alkaline Hydrolysis” is effective in treating agrochemical contaminated water. When considering the statistics of COD comparison, it indicates a clear difference of mean values, coefficient of variance is nearly the same indicating the span of data is almost the same over the mean values. Therefore it can be concluded that raw effluent has a higher COD than the treated water samples. Further when considering pesticide analysis, it has shown raw wastewater which contained high amount of pesticide active ingredients has decreased and became non detectable after treating. This clearly showed “Alkaline Hydrolysis” has the ability to lower the toxicity. When considering the bio assay all the physico chemical conditions of the test media during the toxicity tests were fairly constant. The pH ranged between 7.5-7.8, Dissolved Oxygen (DO) was between 6.5 and 7 mg L⁻¹ while temperature ranged between 28.0 and 31 °C over 96 hours toxicity evaluation. The results of the toxicity test of treated effluent on *P.reticulata* in 24, 48, 72 and 96 h of exposure showed mortality shown in Figure 1.

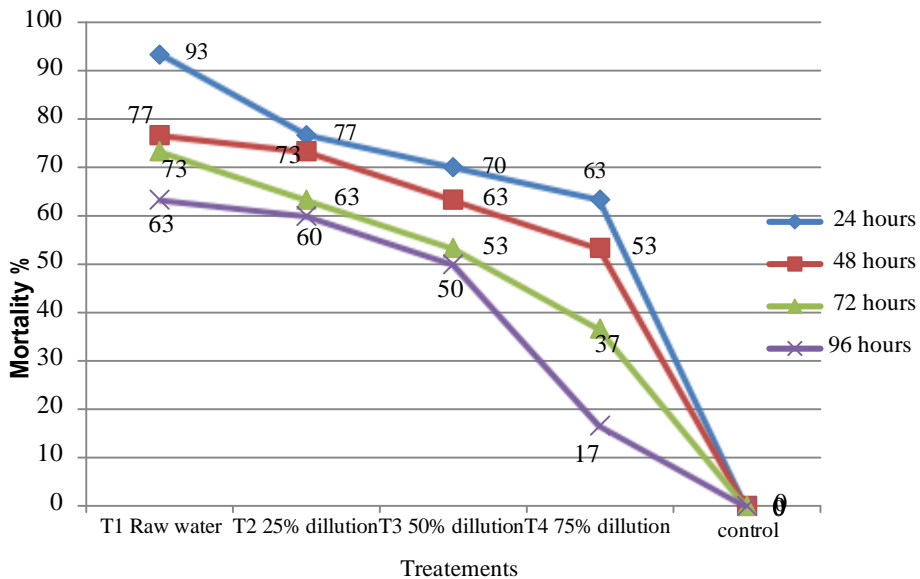


Figure 01: Treatments Vs Mortality

No adverse behavioral changes or any mortality was recorded in the control fish tanks throughout the period of bio assay. Symptoms of toxicosis observed in the behavioral of fish exposed to test media. Before the eventual death species showed lack of balance erratic swimming and restlessness. In the study highest mortality was recorded, in less diluted effluent and lowest exposure time (24 h), lowest mortality was recorded in highest dilution (75%) and longest exposure time (96 h). The findings in this study has revealed that when discharging the agrochemical contaminated waste water after hydrolyzation, it should be mixed with rain or storm water and keep the contaminated water in the maturation tank for further degradation. Because in the study it has shown highest dilution and highest exposure duration caused minimum

mortality. According to the results which were obtained from bio-assay to avoid the effect to the ecosystem, dilution should be done. Therefore before discharging treated water to the outer ecosystems, it should be subjected to proper dilution. Then the negative effect to the ecosystems can be minimized. This study showed that at 96 h exposure in high dilution (75%) caused minimum mortality. Toxicity has shown to increase with lowering the dilution. The exposure of *P. reticulata* to treated wastewater which was contaminated by agrochemical (Profenofos) exhibited aggressive behavior, rapid gulping water, increased opercular movements. *P. reticulata* was stressed progressively with the time before death. Analysis of Variance (ANOVA) showed that there was significant difference ($p < 0.005$) in the quantal response at 24, 48, 72 and 96 hours of exposure in each dilution level. The findings in this study have revealed that agrochemical is toxic to fish and suitable treatment method can detoxify the toxicity of them. Establishing proper treatment methods are highly recommended for contaminated areas.

Conclusion

Study is suggested toxicity depends on dilution and exposure time. Alkaline hydrolyzation is one of the best treatment methods that can be applied to the agrochemical contaminated areas. Most suitable option that can be taken to alter the problem is keeping the treated effluent in a maturation tank for one month like period and mixed that with rain or storm water with a suitable dilution factor before discharge to the natural environment. Therefore the toxicity and remaining active ingredients can be degraded naturally with the time. And by the time it will be subjected to natural hydrolysis also. This will reduce further bioaccumulation in ecosystems.

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Reference

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