World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:9, No:10, 2015

Determination of Cyanotoxins from Leeukraal and Klipvoor Dams

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Abstract : South Africa's water resources quality is becoming more and more weakened by eutrophication, which deteriorates its usability. Thirty five percent of fresh water resources are eutrophic to hypertrophic, including grossly-enriched reservoirs that go beyond the globally-accepted definition of hypertrophy. Failing infrastructure adds to the problem of contaminated urban runoff which encompasses an important fraction of flows to inland reservoirs, particularly in the non-coastal, economic heartland of the country. Eutrophication threatens the provision of potable and irrigation water in the country because of the dependence on fresh water resources. Eutrophicated water reservoirs increase water treatment costs, leads to unsuitability for recreational purposes and health risks to human and animal livelihood due to algal proliferation. Eutrophication is caused by high concentrations of phosphorus and nitrogen in water bodies. In South Africa, Microsystis and Anabaena are widely distributed cyanobacteria, with Microcystis being the most dominant bloom-forming cyanobacterial species associated with toxin production. Two impoundments were selected, namely the Klipvoor and Leeukraal dams as they are mainly used for fishing, recreational, agricultural and to some extent, potable water purposes. The total oxidized nitrogen and total phosphorus concentration were determined as causative nutrients for eutrophication. Chlorophyll a and total microcystins, as well as the identification of cyanobacteria was conducted as indicators of cyanobacterial infestation. The orthophosphate concentration was determined by subjecting the samples to digestion and filtration followed by spectrophotometric analysis of total phosphates and dissolved phosphates using Aquakem kits. The total oxidized nitrates analysis was conducted by initially conducting filtration followed by spectrophotometric analysis. Chlorophyll a was quantified spectrophotometrically by measuring the absorbance of before and after acidification. Microcystins were detected using the Quantiplate Microcystin Kit, as well as microscopic identification of cyanobacterial species. The Klipvoor dam was found to be hypertrophic throughout the study period as the mean Chlorophyll a concentration was 269.4µg/l which exceeds the mean value for the hypertrophic state. The mean Total Phosphorus concentration was >0.130mg/l, and the total microcystin concentration was > 2.5µg/l throughout the study. The most predominant algal species were found to be the Microcystis. The Leeukraal dam was found to be mesotrophic with the potential of it becoming eutrophic as the mean concentration for chlorophyll a was 18.49 µg/l with the mean Total Phosphorus > 0.130mg/l and the Total Microcystin concentration < 0.16µg/l. The cyanobacterial species identified in Leeukraal have been classified as those that do not pose a potential risk to any impoundment. Microcystis was present throughout the sampling period and dominant during the warmer seasons. The high nutrient concentrations led to the dominance of Microcystis that resulted in high levels of microcystins rendering the impoundments, particularly Klipvoor undesirable for utilisation.

Keywords : nitrogen, phosphorus, cyanobacteria, microcystins
Conference Title : ICEET 2015 : International Conference on Civil, Environmental Engineering and Technology
Conference Location : London, United Kingdom
Conference Dates : October 23-24, 2015