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Industrial Pollution

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Editorial

Nature is so kind and gracious to the inhabitants of this beautiful planet Earth and its intelligent monitoring renders this planet ecologically well balanced making the life on this planet happy and comfortable. The one who exploits the resources of this planet to its fullest extent is the human his incessant search and research for alternatives to derive more comforts, benefits and facilities lead to the ecological imbalance in the nature.

Rapid industrialization has led to an economic prosperity, doubtless, but this drastic rise in living standards accompanied by deterioration of environmental balance and hence quality. This situation is not only confined to our country, but all over the world. The environment is becoming more and more polluted; mainly air and water pollution has become a major threat to the very existence of living organisms in aquatic environment. A huge quantity of pollutants in the form of domestic, agricultural run offs and industrial effluent are discharged directly or indirectly into the water bodies, which have severe impact on its biotic and abiotic environment because these effluent are known to exhibit toxicity towards different aquatic organisms. The rate of discharge of these materials into the ecosystem is more than the rate of their degradation by natural process, resulting in an undesirable accumulation of such substances in the environment.

Before discharge of wastewater/effluent into the recipient, it is necessary on a mandatory basis for any Industrial organization to purify wastewater/effluent discharges with respect to these pollutants with adequate treatment in a way and to an extent that does not threaten the natural process and does not disqualify them from the possibility of their multi-functional use [1]. The regulation of quality of industrial effluent discharged into the out-let water bodies is utmost necessary in order to preserve environmental sanctity and prevent any adverse effects caused by these effluent discharges containing toxic substances. The physico-chemical and biological parameters used for regulatory purpose by the statutory authorities may be categorized broadly as A) Cause parameters and B) Effect parameters. The 'cause parameters' are mainly physico-chemical parameters, which are liable to cause damage to the environment. The effect of cause parameters are generally reflected by the 'effect parameters', which include mainly biological parameters or Bioassay [2].

In many developed countries toxicity tests on industrial effluent are mandatory to ensure that discharges will not cause adverse effects on the aquatic organisms in the receiving water systems. For instance, the U.S. Environmental Protection Agency has incorporated various aquatic toxicity tests in National Pollutant Discharge Elimination System (NPDES). However, in some countries the local governments still rely only on chemical or physical characteristics of effluent, such as biochemical oxygen demand, pH, temperature, suspended solids, and concentration of various chemicals, to monitor and regulate a point source discharge. This strategy was proved to be inappropriate and inadequate to protect aquatic organisms [3].

The detection of physico-chemical parameters alone is not sufficient, as the wastewater generated from the small scale industries may process large amounts of chemicals, many of which may be present in such low concentrations beyond their detection limits and for many of them even the analytical techniques are inadequate [3,4]. Secondly, the physico- chemical analysis is not only quite complicated, expensive and time consuming process, but also lacks the information about additive, antagonistic or synergistic effects of various chemicals on biotic community in aquatic ecosystem. Therefore, development of effective tools for the evaluation of adverse effects on living organisms is what all that is required. The toxicity is one such 'effect parameter', which provides information about the other relevant parameters too and thus, recognized as 'summary parameter' [2]. The use of summary parameter like toxicity is significantly gaining importance all over the world because, it is simple, easy, and less expensive when compared to the physico-chemical parameters and it is also acceptable legally and scientifically.

In general, toxicity tests may be i) static non-renewal, ii) static renewal, and iii) flow-through. But the simplest is the acute static non-renewal test, where the test solution remains the same throughout the test. An acute toxicity test measures the lethal effects over a short period of time (48 hrs). As per the guidelines of the Indian standards [5] for testing of industrial water and wastewater, 'static non-renewal toxicity test method' has been suggested and the same is adopted.

Toxicity tests or bio-assay tests provide the impact of chemicals on both the aquatic and terrestrial organisms. They play a vital role in providing data on chemical toxicity, determining organism's sensitivity and stipulate water quality suitable for consumption. The method has been prevalent right from eighteenth century. Increased use of pesticides for agricultural and other purposes, the toxicity tests gained an enormous momentum using invertebrates and fish. The toxicity tests have also been emphasized by Organization for Economic Cooperation and Development (OECD) and the European Economic Community [6]. The OECD had even offered a package of test procedures covering the minimum requirement of simple 'toxicity tests' and more extensive tests like 'bio-magnification' and 'bioaccumulation' for toxicity evaluation. The toxicity testing has become now the 'work house' for detection, evaluation and abatement of water pollution. These tests which can also be referred as bioassay tests are widely used to determine the potency of physiologically active substance of unknown activity. The toxicity factor as outlined above is an essential parameter to assess the effect and survival of organisms to toxicants in aquatic eco-systems. The initial misconception that the toxicity or bioassay tests are complicated, require extensive infrastructure, time consuming, inaccurate and unreliable has been removed by the development of a user-friendly method by Central

Pollution Control Board (CPCB) which has been adopted by Bureau of Indian Standards and this developed method has been recognized as an Indian Standard test method. In fact the toxicity test, being easier, cheaper, more effective and less time consuming is one of the important parameters covering all above shortcomings can be used as a 'summary parameter'. The regulatory bodies use the toxicity results in terms of 'toxicity factor' or 'dilution factor'. The toxicity factor is a dimensionless number representing number of times an effluent needs to be diluted on log scale at which hundred per cent survival of specific test organism under specified conditions is ensured [7].

Bioassay tests have been developed and used for evaluating the acute toxicity of the pollutants in the effluent streams. These tests have become mandatory to protect aquatic eco-system. Experimental methods have been devised in the laboratory to estimate the level of toxicity and their impact on the aquatic organisms. The experiments were carried out by exposing the sensitive organisms such as fish, invertebrates or algae to the diluted or undiluted wastewater under controlled laboratory conditions. The test organisms have been chosen in such a way that they can be easily maintained under the given laboratory conditions, sensitive even to the minimal quantities of the toxic substances in wastewater [8]. When dilute water was used for toxicity testing the test revealed the natural mixing of the effluent with the receiving water. The dilution water experiments showed that the situation has improved when the quality of water in the flow was increased, the dilution effect can probably be expected more during rainy days. Both toxicity test and physico-chemical analysis provide complete and realistic data on effect of wastewater to aquatic life for subsequent monitoring of the treatments.

Zebra fish have proven to be attractive to toxicity experimental evaluation as it was found that can be easily maintained and breeding in laboratory, easily facilitated free of pathogenic microorganisms and deliver the eggs of high quality irrespective of any season [9]. Bureau of Indian Standards [5] have recommended Zebra fish for toxicity testing of industrial water and wastewater. Acute static non-renewal toxicity testing method has been prescribed by Indian standards. Acute toxicity tests measure the lethal levels of pollutants over a short period of time i.e., within 48 hrs. These tests largely help in the assessment of possible risk to similar species in natural environment since they are sensitive indicators for environmental contamination.

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