COASTAL CONSERVATION PROBLEMS : PROTECTION OF WASTEWATER TREATMENT PLANTS FROM TOXIC INDUSTRIAL EFFLUENTS

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Limited freshwater resources as well as densely populated coastlines which have to be protected from the discharge of untreated sewage and wastewaters have led to the widespread use of wastewater treatment plants in many islands in the Mediterranean. Nonetheless the efficiency of such wastewater treatment plants depends very much on the quality of effluents they have to act upon. Certain stages in the bio-treatment processes such as nitrification are quite sensitive to toxic industrial effluents. Nitrification, or the conversion of ammonia to nitrate by autotrophic microbial activity, is essential in the treatment of wastewaters for a number of reasons, namely :

a) nitrification prevents the discharge to receiving waters of ammonia. This is toxic to fish at concentrations as low as 0.5 mg l^{-1}, especially at high pH conditions.

b) nitrification in the receiving water exerts a significant oxygen demand and thus can deplete the dissolved oxygen resources of the surface waters

c) nitrification can have also financial implications where disinfection at the sewage treatment works is achieved by maintaining a trace of free chlorine in the final effluent. In the presence of high concentration of NH_3, the chlorine dose required to reach breakpoint chlorination would be several times the NH_3 concentration and thus would be prohibitively expensive.

The above reasons have led to an increasing tendency towards the requirement of some degree of nitrification at sewage treatment works. However nitrification is an extremely sensitive process which is influenced by factors such as dissolved oxygen concentration, pH and temperature. The engineer has control over these factors. In contrast , the engineer does not have control over the presence of toxic compounds in the sewage that may inhibit the nitrification process. In fact a wide variety of organic and inorganic compounds that inhibit nitrification are present in industrial wastewaters.

In Malta, presently all industrial wastewaters are discharged into the municipal sewer system. No analytical information as regards the quantity and the quality of industrial wastewaters generated by industries in Malta is available. The only indication regarding the nature of the effluents can be inferred by consideration of their activities and the products manufactured. In this respect, the scope of this work was to investigate a biological assessment method to assess the degree of inhibition to nitrification by industrial wastewaters, and thus to determine whether a particular industrial wastewater can be discharged to sewage treatment works, so as to protect the treatment plant from upsets and reduced nitrification rates.

The potential nitrifying ability of the activated sludge sampled from the Sant Antnin Wastewater Treatment Plant was assessed by centrifuging, washing and recentrifuging the sludge to remove any oxidized nitrogen and any inhibiting toxins. The sludge was mixed with a standard medium containing an excess of ammonium salts at pH 7.4 and the mixture was incubated with adequate aeration for four hours. The specific rate of nitrification was then calculated from the concentration of suspended solids and the decrease in the concentration of ammonia. This was carried out routinely in order to assess the variability in the nitrification performance which is to be expected within treatment plants even under optimal working conditions.

The degree of inhibition of nitrification by industrial wastewaters was calculated by assessing the decrease in concentration of ammonia nitrogen after parallel aeration of a nitrifying sludge obtained from Sant Antnin Sewage Treatment Plant, in the presence of different dilutions or absence of the particular industrial effluent. Effluents from three types of local industries were sampled on various days throughout 1992 and investigated. These were a tannery, galvanising and electroplating complexes. Effect on nitrification was expressed as that dilution of effluent which causes a 25% reduction in nitrification (25% Effective Concentration: EC25).

Effluents from the galvanizing factory failed to exhibit significant reduction in nitrification. On the other hand, effluents from the tannery showed an EC50 of 0.28 ml per 100 ml. This dilution factor is approximately equal to that found at the sewers. This implies that a 25% reduction in nitrification performance would be expected at the treatment plant if such effluents reach it at this dilution.

The biological test investigated has several advantages that favour the adoption of this protocol as a screening method for the discharge of industrial effluents in the sewerage system.

Standards for effluent quality should continue to be directed towards the regulation of the amount of toxicant and physical changes. However, a biological test procedure such as the one investigated, should also be carried out. Even if the effluent conforms to all limitations imposed by present standards for discharge of toxic materials, there is a high probability that a number of deleterious effects will result on the sewage treatment works from both synergistic actions and enhancement of toxic effects. Effective protection of the coastal environment often depends on the efficient operation of wastewater plants. The use of this biological test for effluent quality may help ensure such desired efficiency.