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EFFECT OF POWER PLANT WASTES ON COASTAL
ENVIRONMENT

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ABSTRACT

The neritic water is of great environmental concern due to the fact that they are not only the most productive areas but also considered as the dumping ground for the wastes released by the human activities. These areas experienced the world's most crucial pollution problems. The ecological significance of coastal aquatic environment in relation to thermal effluent and fly ash disposed by the thermal power plant is discussed in this paper. Thermal power plants utilize large volumes of water as a transfer medium to remove the heat from the condensers and dissipate it into the environment. The temperature of the cooling water is therefore raised 5.0° to 9.0° C generally, but even raised more during summer months. As a result salinity is increased and the concentration of dissolved oxygen is lowered. Reduction of zooplankton population, lesser benthic species diversity and avoidance of fish species were noticed near the heated effluent discharging sites. Fly ash, a biproduct of coal, is disposed into the adjacent areas of power plant, contain several toxic trace elements, which are harmful to aquatic biota. Continuous deposition of fly ash can contaminate the sediment and there by changing the particle size composition of the soil and the bottom becomes unsuitable for settlement of benthic fauna and related fish population.

Key words : Human activities, pollution, zooplankton, benthic fauna, biproduct.

INTRODUCTION

The use of seawater for cooling purposes, particularly for cooling the condensers in electrical generating plants is wide-spread and increasing. These cooling system can change water movement, turbidity, temperature and chemical concentrations in receiving waters. Tropical environments often present quite different problems than the temperature ones. The first is that the organisms occurring in tropical waters are much closer to their thermal limits than those of temperate waters, especially in summer, may be either inhibitory or lethal, depending on their range, rate of change and duration¹. A slight increase in temperature such as that caused by the thermal discharges therefore may push the organisms over the tolerance limit and impairing the metabolic activity². Discharge of bottom ash and fly ash from power plants can also cause heavy metal pollution to the sediment as well as atmosphere. Monitoring permissible level of these harmful elements is necessary to safe guard otherwise very delicately balanced aquatic environment. Therefore, this paper deals with the possible effects of thermal effluent, bottom ash and fly ash wastes discharged from thermal power plant on water quality, biological components and sediment characteristics of the receiving coastal environment.

EFFECT ON WATER QUALITY

One of the two physical characteristics of aquatic habitat must altered by electricity generating installation is the temperature, the other being water movement³. The temperature rise in cooling water between the intake and outfall is usually in the range of 8.0 - 12.0°C.^{4,5,6}

Mukhopadhyay⁷ have stated that the heated effluent discharged from the cooling plant of the thermal power station into the Hooghly estuary influences the estuarine water temperature down stream upto

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400 - 500 meters during low tide and upto 100 meters upstream during high tide. The maximum seawater temperature of 42.3°C has been recorded at 100 meters distances away from thermal effluent discharging point and 33.0°C at 1500 meters distance away from heated effluent discharging point with temperature elevation of 9.3°C in Tuticorin caused by Tuticorin thermal power plant.⁸

The effect of cooling water discharge on the receiving water depends on many factors including dilution, water current, shape, size and construction of outfall, plant operating condition and maintenance programme. The increased water temperature also causes increased salinity pattern due to evaporation and precipitation.⁹ have observed positive correlation of salinity with water temperature at the out fall site of thermal effluent along the Kalpakkam coast.

Dissolved oxygen has been considered to be one of the important constituents of biological significance which can be influenced by thermal power generating systems. The fact that high temperatures may be associated with low concentration of dissolved oxygen particularly in areas receiving oxidizable effluents as well as heat¹⁰. Nugent¹¹ has reported that the concentration is dissolved oxygen in the cooling water is decreased to about 1ml/l as it passes through the plant and down the effluent canal in which the temperature noticed was higher than that of ambient water.

Turbidity is one of the important physical parameters of sea water which has a significant bearing on its productivity.¹² According to Williams¹³, turbidity modifies the transmission of light through a column of the sea water and the total extinction varies proportionately to the concentration of suspended solid material. Filter feeding organisms such as oysters are very sensitive to suspended silt and other substances may decrease the pumping rate of the filter feeding mechanisms¹⁴ Kastendick¹⁵ have stated that the heated effluent discharge causes the transport of bottom waters upward which carries

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large amounts of suspended materials from the bottom of the surface, creating turbidity plume at the surface.

The level of primary production in an aquatic system can be used as a tool of estimating the standing crop of phytoplankton community.¹⁶ Primary productivity varies considerably in proportion to environmental parameters such as light intensity, turbidity, water temperature and inorganic nutrients available in the water.¹⁷ If the water temperature is higher caused by heated effluent discharge, the rate of photosynthesis will be lower.^{18,3}

The proportion of sand, silt and clay of sediment is of great importance for the distribution of many organisms since the porosity and interstitial space are directly controlled by the relative abundance of different sized particles and these parameters are critical for organisms within the sediment. The sediment texture is dependent on the size, shape and degree of packing of particles and these are controlled by water movement.^{19,20} Sediments are poorer conductors of heat than seawater, so absorb heat more slowly. On the other hand, once that sediment become heated they will retain the heat much longer. Therefore, an intermittent heating of the water if sufficiently great, can produce a lasting effect in the sediment, which will retain its heat after the water has cooled and act as a heat reservoir for the system. This fact is important for the sea grasses, but will also affect the rhizoids and spores of the seaweeds and will help to delay their regeneration after the water temperature has fallen again.

BIOLOGICAL IMPACT OF HEATED EFFLUENT

Electric-power generating stations usually entrain large volumes of water for cooling purposes in the production of electricity. Zooplankton in the entrained seawater may be affected by thermal, mechanical or chlorination stress during their passage through power

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station condensers. About 70% of the copepods entering the cooling water system of a nuclear power plant on north eastern long Island sound (USA) are not returned in the effluent.²¹ After passing through the powerplant, copepods sink rapidly and leads to an increase in concentration of copepods suspended in the deep water of the effluent pond. This copepod mortality caused by the power plant reflects the loss in secondary production.

There is an increasing awareness of the usefulness of benthic community in the detection and monitoring of coastal and estuarine changes²² Thorhaug and Roessler²³ while studying the impact of thermal effluent on the biota of Biscayne bay have reported that the seagrass community, *Thalassia spp* and associated organisms decreased in species composition, diversity and density both seasonally and annually thus showing the influence of high water temperature caused by thermal effluent discharge. Benthic species diversity was less in thermal effluent affected area of Tuticorin bay Tamilnadu, India was recorded by Kailasam⁸. The density and diversity of benthic infauna could be largely decreased when associated with the water temperature range of 34.0°C - 37.0°C produced by a power plant. Barnacle settlement was lowered due to high velocity of water current in the vicinity of cooling water pump discharges from power generating station.²⁴

EFFECT OF FLY ASH ON ATMOSPHERE AND COASTAL WATER

Fly ash, among other things, contain some of the highly toxic trace metals. Though, these are present in very small quantities, with the increasing amount of coal consumption, they can prove to be dangerous to plants, animals and human beings alike. When coal is burned as a fuel to produce heat for the generation of electricity, the major pollutant is fly ash. Fly ash usually consists of dark, irregularly shaped particles, angular, transparent and opaque particles, glassy spheres and globules. Coal also emit sulphur dioxide, nitrogen oxide,

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carbon monoxide and hydrocarbons in to atmosphere when it burns. These pollutants might remain as such in the atmosphere or get transformed into several other compounds by various physical and chemical reactions, namely, photo chemical, hydrolysis catalytic oxidation, polymerisation and condensation. High concentration of these pollutants in atmosphere can cause acid rain problem and defect in ozone layer.

Fly ash is mainly disposed off by treating it in artificial shallow pools near the plants. However, in many cases it is not properly treated and utilised. So stockpiles of fly ash can continue to grow as reliance on coal burnt fuel source increases. Heaps of fly ash are easily washed away by rain. Soluble trace elements from fly ash can easily mix with adjacent water body. High concentration of aluminium, manganese and boron from fly ash may be toxic to aquatic life. However, other elements like cadmium, potassium, magnesium and sodium which are readily released in water are of no apparent toxicological concern.

The presence of several natural elements in fly ash (Sodium, potassium, mercury, chromium, zinc, iron, cobalt) has marked effect on the physico-chemical properties of soil from the point of view of crop production. Various studies done in India and abroad indicate that the application fly ash soil reduces the bulk density (the mass of powdered or granulated soil per unit volume) and increases water holding capacity of soil-fly ash mixtures. Surprisingly, while this decreased bulk density makes the soil more prone to wind erosion, the increase in water-ho. and Moitra, S.oes not produce any significant inplant available water. In certain cases, the cementing nature of fly ash results in water-logging.²⁵

CONCLUSION

The generation of electricity is very important in order to meet the electricity demand from various industrial and agricultural sectors. At the same time, the life of aquatic organisms and ecological balance are also equally important from an environmental conservation point of view. Therefore, it is very essential that appropriate remedial measures are resorted to in order to protect marine life from the stresses caused by thermal pollution.

The usage of warm water effluent for aquaculture practices is of recent interest and generally is in practice in temperate countries.³ In tropical countries like India, where the water temperature is nearer to lethal limit especially during summer months, the scope for usage of heated effluent for aquaculture purposes is limited. Therefore it is suggested that the thermal effluent can be diverted into a confined area and after cooling the effluent there, the same water can be recycled and used for cooling the condensers.

Dumping of the bottom ash directly into the sea is a long term problem especially for the recruitment of native species in this region. Since the bottom ash is an indispensable part of thermal power stations, it is suggested that profitable use of bottom ash be made in the production of building materials such as bricks and cements which will help in a long way in meeting the ever increasing demand of construction materials.

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