M.S.42. BALCHAND, A.N.–Studies on the Dynamics and Water Quality of the Muvattupuzha River in relation to Effluent Discharge–1984–Dr. P.N.K. Nambisan and Dr. P.G. Kurup.

Tropical river-estuarine-nearshore system has been found to function in a rhythm quite different from those of mid & upper latitudes. As such, the natural geochemical cycles best reflect the dominant features to include the annual transport of rich silt laden particulates across the fresh-estuarine-marine waters. A comprehensive programme devoted to the study of chemical aspects of these natural systems would serve to full fill numerous scienific objectives of the complex ecosystem Lately urban agglomeration, industrial expansion, varied agricultural practises have influencedd the built-in nature of these regimes, studies on which, to a large extent is a measure of environmental quality/quantity changes. The thesis accounts for the study of a tropical river-estuarine system (water quality & dynamics) before and after receiving effluent discharges from a pulp-paper factory. (Period of field survey Oct. 1980 to Sept. 1982).

The south-central parts of state of Kerala comprises of two large river basins of Periyar R and Muvattupuzha R. Since late 1976, water from Periyar R. catchment area is being diverted into Muvattupuzha R. through Idukki dam and Moolamattom power station. The river water serves all the requirements of the locality and is utilised for agriculture, domestic purposes, recreation etc. A 400-tonnes per day newsprint factory is located 12.5 km from Muvattupuzha river mouth, designed to discharge its effluent into the river.

The water quality prior to effluent discharges indicated good potable water of high standards. The water is nearly saturatd with Oxygen (DO-6.0-11.5 mg/1) and pH lies within 6.85 to 7.20. The amount of suspended solids were low (2-30

mg/1) and BOD ranged between 0.5 and 3.0 mg/1. The content of nutrients were also low and mercury in river water was 0.0005 mg/1.

The factory discharged effluents: 0.65-1.0 m^3/sec, of DO 0.5-3.5 m1/1, pH 4.5-8.7, suspended solids content being 80-250 mg/1 and BOD ranging between 10-5000 mg/1. The river water after receiving the newsprint effluents indicated pH 6.0-8.3, suspended solids 50-140 mg/1, BOD 1.5-50 mg/1. The organic carbon content of sediments collected from downstream pools were high (1.5-9.0%) compared to values (0.5-1.4%) before waste dischrge. Large quantities of nutrients were also detected in the river water. Persisting presence of mercury in levels ranging from 0.0012-0.05 mg/1 was observed during effluent discharges.

Studies on the physiography and flow characteristics reveal that the discharge in Muvattupuzha river has increased from 4-7 m^3/sec to 50 m^3/sec in dry season since the discharge of tail race waters. The climatic conditions favour a peak discharge (400 m^3/sec) during June-July months coinciding with the peak south-west monsoon. Studies on the interaction between tides and river flow indicate that the lower river reach of about 30 km is affected by tides, by way of periodic rise and fall of water level with no upstream currents. A minimum river discharge of 30m^3/sec was worked out statistically for a typical tide just to prevent upstream flow at effluent cutfall point. The implications of a forthcoming water resource project (Malankara Balancing Reservoir) are discussed in the light of the tidal behaviour of the river.

The dispersion pattern at the effluent outfall region was studied by conducting two tracer experiments. The results indicated that the dispersion was not effective enough to cause the required dilution of the effluents. This was observed to be true in the actual situation. The location of outfall has drawbacks with regard to the upstream slope, backcurrents and curvature effect apart from the deficiency in design of the diffuser part.

The organic loading capacity of the river was calculated using a modified version of Streeter-Phelps formula.

$$L_t = L_o 10^{-(K_1 + K_3)t}$$

$$D_t = \frac{K_1 L_o}{K_2 - (K_1 + K_3)} [10^{-(K_1 + K_3)t} - 10^{-K_2 t}] + D_o 10^{-K_2 t}$$

Where L_o = Initial BOD (mg/1), L_t = Ultimate BOD after time 't' (mg/1), D_o = Initial DO deficit (deficit = saturation DO value - observed DO) (mg/1), D_t = DO deficit after time 't' (mg/1), t = time (seconds or days), K_1 = Deoxygenation co-efficient/day, K_2 = Reaeration co-efficient/day and K_3 = +ve values for rate of removal of BOD due to sedimentation or volatilization/day and -ve values for rate of addition of BOD due to scouring of bottom deposits/day.

The profiles using Oxygen Sag curves were derived for different BOD loads and were found comparable with observed values. Under present conditions, in order to maintain the entire stretch of the river downstream of outfall well above the tolerance limit for DO (3 mg/1 or 40% of saturation value, whichever is higher) a value of BOD 300 mg/1 has been estimated as the maximum assimilative capacity for this river.

An impending problem of pollution is connected to the untreated sludge disposed in a low field, flooding during monsoon. The sludge contains cooling pond waste, organic matter like fibre, wood chips, cinder ash, lime mud etc.

which may find way into the neighbouring agricultural fields and contaminate ground water. The overall results indicate that the river water downstream of the outfall is polluted rendering water unsuitable for drinking, bathing, recreation and agricultural purposes. The pollution problems may further aggravate, once the Malankara balancing reservoir diverts nearly 2/3rd discharge in the river causing active tidal intrusions upstream of the outfall.