Paper 04
Design and Construction of Low Cost Package Treatment Plant Using Poly Ethylene (PE) Tanks

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INTRODUCTION

National Water Supply & Drainage Board operates more than 325 water supply schemes throughout the Island. Among these, only a limited number of schemes have full treatment processes while others consists of partial treatment facilities. Raw water quality has changed severely during the last few years and partial treatment facilities are inadequate to treat present raw water. Due to the large cost involvement in construction of a conventional concrete full treatment facility, converting partial treatment systems to full treatment plants has become a difficult task.

Therefore, recently NWS&DB initiated to study on low cost techniques to construct adequate treatment facilities. As a result NWS&DB has introduced steel package treatment modules. However, main reasons for slow execution of these package plants are due to the less durability, heavy weight hampering the transportation and erection and the considerably higher cost. The objective of this study is to design and construct a durable and low cost package treatment module using Poly Ethylene (PE) Tanks.

HIGHLIGHTS

- Studied low cost techniques for construction of treatment plants.
- Designed PE package treatment units with flocculator, tube settler and rapid sand filter.
- Pilot plant was installed to investigate the performance.

METHODOLOGY

PE plates and PE tanks which are available in the market was selected for this study. Two types of flocculator units which are having 500m^3/day capacity were designed; a horizontal flow hydraulic flocculator and a vertical flow hydraulic flocculator. The flocculator unit was manufactured at a PE factory. During the manufacturing it was revealed that manufacturing of 500m^3/day capacity flocculator is not economical. In addition there were some technical difficulties to complete the product. Therefore, the capacity of the flocculator unit was changed to 750m^3/day. Detention time of the flocculator was selected as 20minutes. A schematic diagram is shown in Figure 1. A manufactured and installed flocculator unit is shown in Figure 2. Steel support frame was designed to avoid any deformations and to facilitate the transportation.

A 10 cubic meter capacity PE tank available in the market was used for construction of the tube settler. 50mm diameter type 400 PVC pipes were used for tubes. PVC pipes were placed vertically throughout the tank section. In order to achieve the optimum angle of tube settlers the tank was angled by 60 deg. A schematic diagram is given in Figure 3. An installed tube settler is shown in Figure 4. Treatment capacity of one unit is 375m^3 day. Hence two tube settler units are required for one flocculator.

A 10 cubic meter capacity PE tank was used for the rapid sand filter. A design similar to the one used by the NWSDB for steel package treatment plants was used. Treatment capacity is 500m^3/day. Figure 5

shows a completed filter unit.

PE package treatment unit was installed in the Eheliyagoda water supply scheme. Eheliyagoda water supply scheme is located in the Rathnapura District.The water source is a small stream called"Bisodola". The only treatment available in the scheme was chlorination. However, during the wet weather treatment plant has to shut down because of the higher turbidity. Recent changes in the catchment area have aggravated the raw water quality problem and need more treatment facilities. A 750m^3/day capacity package treatment module which consists of hydraulic flocculator, tube-settler and rapid sand filter all made of PE tanks as a pilot plant has been installed in Eheliyagoda water supply scheme. Even though two tube settler units are required for one flocculator unit, only one tube settler could be completed.

RESULTS

Treatment efficiency

The plant was operated at different raw water qualities and the turbidity was meassured.Turbidity of raw water and treated water was measured.During the commisioning period maximum turbidity of 183NTU has been recorded and the turbidity of treated water has been reduced below the SLS standard.Turbidity at the tube settler out let is 12NTU.If two tube settlers will be installed for the flow of 750m^3/day, better results can be expected.

Comparison with other package treatment units

The cost of 750m^3/day flocculator is Rs. 1.5 million and the cost of 375m^3/day tube settler is Rs. 0.5 million. Cost of the 500m^3/day capacity rapid sand filter is Rs. 0.5 million.Total cost of the 1500m^3/day treatment module including site work is around Rs. 8.5 million (Rs.5666.00 per m^3/day) and is 14% of the cost of a similar capacity concrete plant and is 22% of the cost of a same capacity steel package module. PE structures are suitable to any environmental condition and the maintenance cost is very low. In addition it is easily movable because of the less weight.The module can be also constructed in a lesser time.

CONCLUSION

Designed PE pakage plant consists of flocculator, tube settler and rapid sand filter which has treatment capacities of 750m^3/day, 375m^3/day and 500m^3/day respectively.Therefore two units of flocculators, four units of tube setlers and three units of rapid sand filters is the best combination for a 1500m^3/day flowrate. Installed pakage plant gave adequate treatment performance. The cost of the treatment module is Rs. 5666.00 per m^3/day and is 14% of the cost of a similar capacity concrete plant and is 22% of the cost of a same capacity steel package module. PE structures are suitable to any environmental condition and the maintenance cost is very low. In addition it is easily movable because of the less weight. The module can be constructed in a lesser time and found to be a solution for many prevailing problems in National Water Supply & Drainage Board. Further this will be an affordable solution for most of the rural water supply schemes operated by local authorities and CBOs.

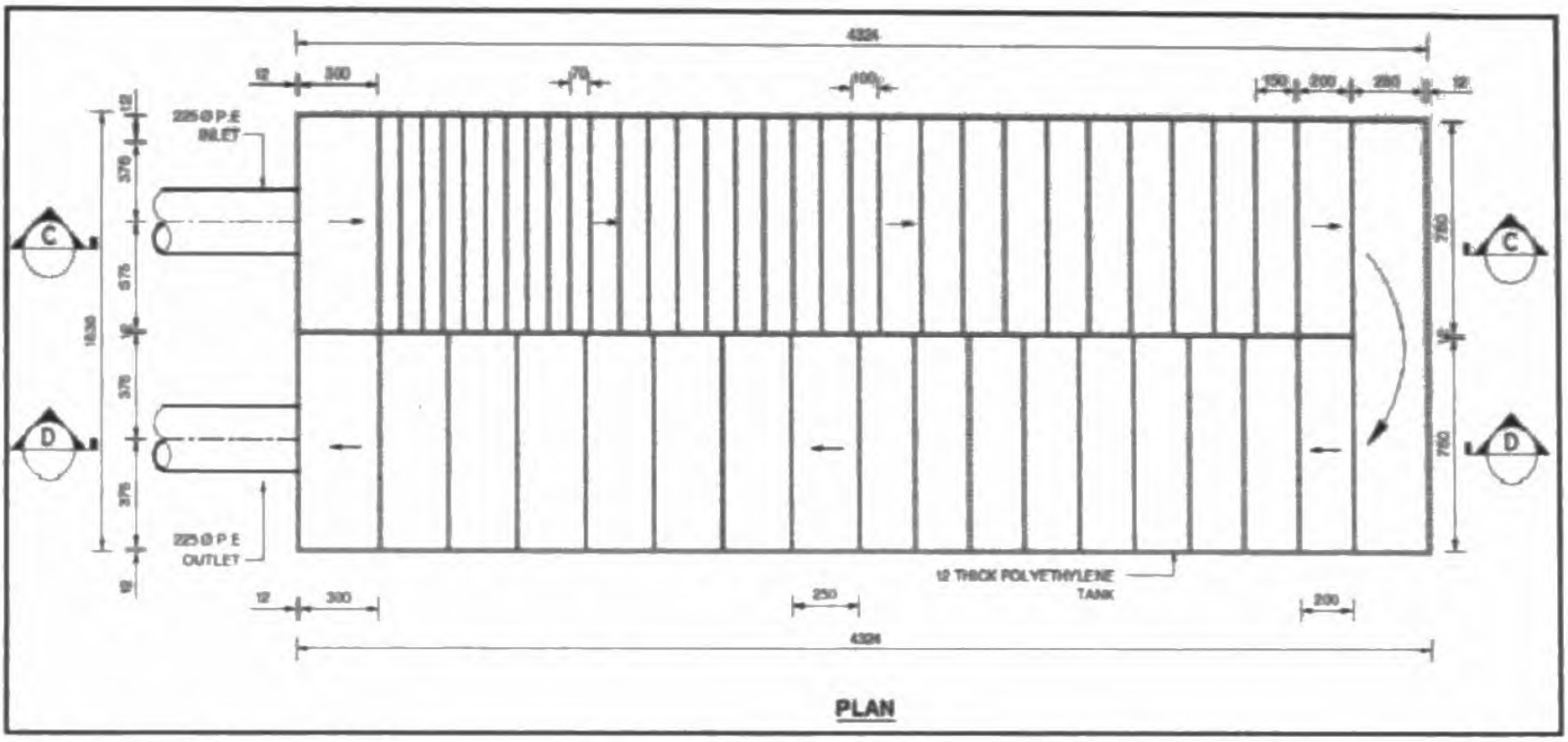

Figure 1: Schematic diagram of the Flocculator

Figure 2: Installed Flocculator Unit

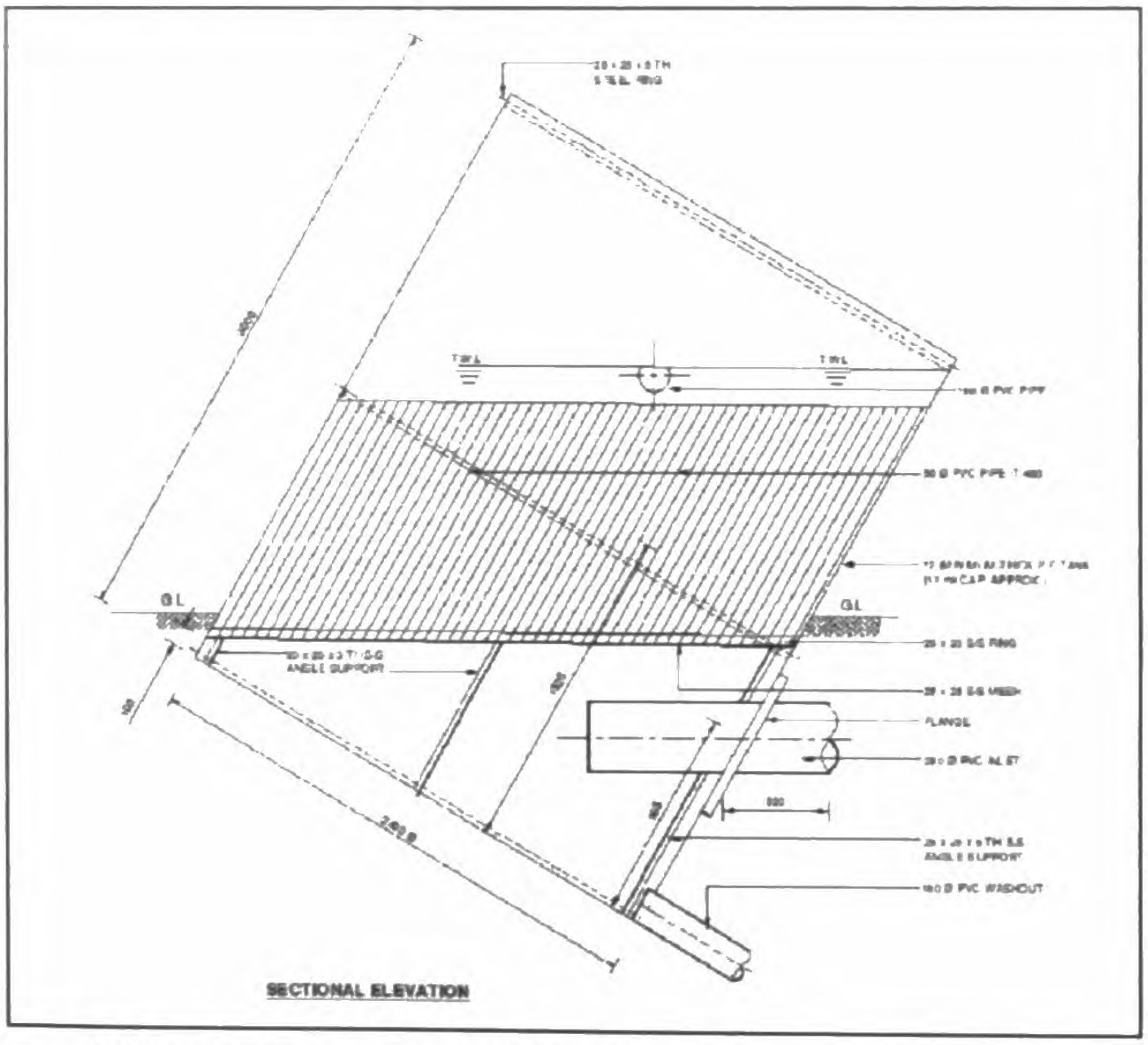

Figure 3: Schematic diagram of the Rapid Sand Filter

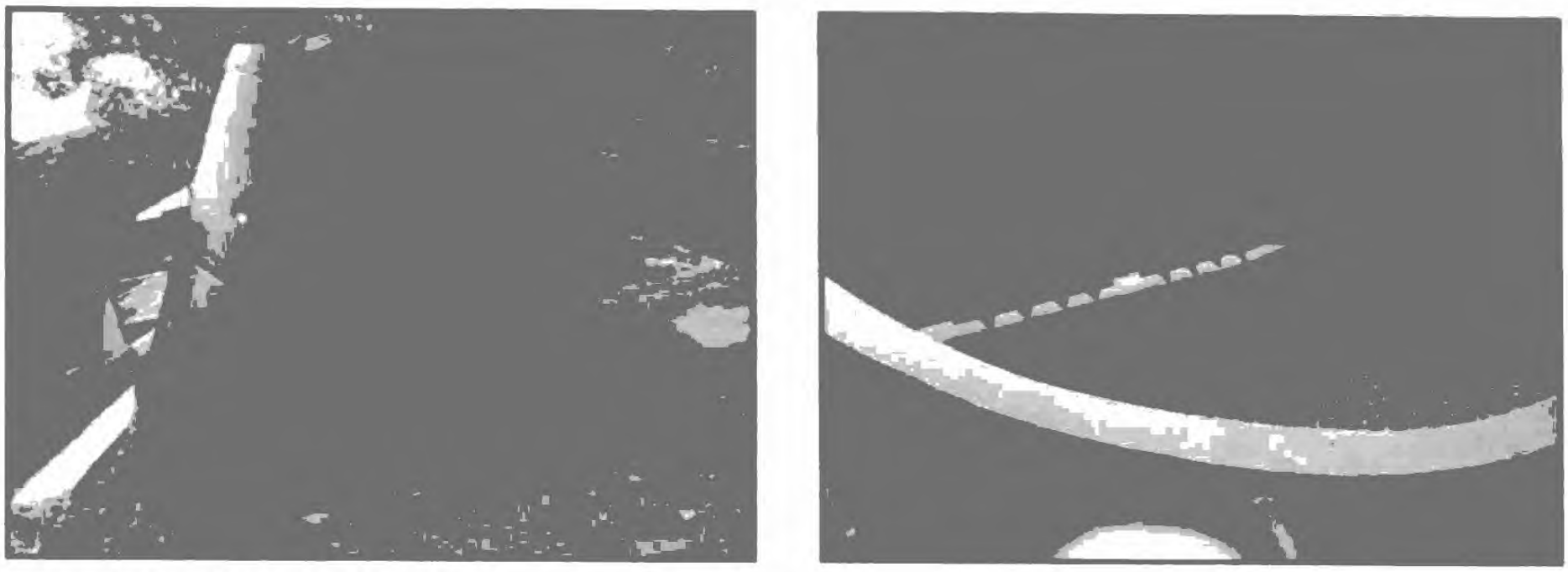

Figure 4: Installed Tube Settler Unit

Figure 5: Installed Rapid Sand Filter unit