SUBSURFACE FLOW CONSTRUCTED WETLANDS IN THE TROPICS: Use of local river sand and cattails (*Typha latifolia L.*) as media & macrophyte respectively

By

OMONDI CHARLES
B. Tech. (Hons) Eng., Reg. Grad. Eng.

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ABSTRACT

The use of constructed wetlands has been widespread in the developed temperate regions. However, insufficient information on the performance of subsurface constructed wetland systems and the subsequent lack of design parameters has limited their application in the tropics. This study involved the application of a horizontal subsurface flow constructed wetland system (HSFCWS) for the treatment of domestic wastewater.

The objectives of the study were to determine whether anaerobic or aerobic process dominate the system, to determine temperature-dependent first order rate constant (K_T) applicable for the design of HSFCWS in the tropics and the measurement of the clogging effect on the media material. A HSFCWS was used since it fulfils more stringent requirement for pollutant removal (BOD, COD, TSS, N and P) per land area unlike free water surface (FWS) systems.

To facilitate the study in real field condition, a pilot plant (4m x 2m x 0.6m) was put up in Moi University, Eldoret, Kenya to enhance the objectives of the study. The emergent vegetation (macrophyte) and the media material used in the system were cattails (*Typha latifolia L.*), and local-river sand respectively.

Test methods were as outlined in the *Standard Methods for water and wastewater analysis, 19th Edition*. Chemical Oxygen Demand (COD) was measured using the closed reflux method, Biochemical Oxygen Demand (BOD) was measured using the Winkler method while dissolved oxygen (DO) and oxidation-reduction potential (ORP) were

measured using the DO-meter and combined pH electrode respectively. Orthophosphates were measured using the colorimetric method. Sieve analysis was applied for the particle size distribution of the media.

Results gave COD values 199.01-35.49 mg/l, BOD values of 144.33-21.00 mg/l, DO values of 0.143-0.064 mg/l and oxidation-reduction potential (ORP) values of 39.97-18.03 mV for the inlet and outlet respectively. COD removal kinetics was applied in the determination of the rate constant and it showed that a rate constant of upto 1.41 d^{-1} could be used for the design of HSFCWS in the tropics. Dissolved Oxygen (DO) and Oxidation-Reduction Potential (ORP) analysis established that anaerobic conditions dominate HSFCWS. Spectrophotometric measurements for orthophosphates, which constitute the limiting nutrient for plant growth, indicated there was a marked reduction although longer retention times are necessary for any better removal. Relationships were developed, based on the particle size distribution, as concerns the period of clogging against hydraulic loading rate (HLR) and suspended loading rate (SSLR) which affect the design life of the HSFCWS