TRICKLING FILTER WITH HEXAGONAL CLOSE - PACKED MEDIA FOR THE TREATMENT OF DOMESTIC WASTEWATERS

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A thesis submitted in fulfillment of the requirements for the award of the degree of Doctor of Philosophy

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<td>$\mu$</td>
<td>Specific growth rate (hr$^{-1}$)</td>
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<td>$X_t$</td>
<td>Cell biomass after time t</td>
</tr>
<tr>
<td>$X_0$</td>
<td>Initial number of biomass cells</td>
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<td>$K_a$</td>
<td>Ionization constant</td>
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<td>$\mu_{\text{max}}$</td>
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<td>$[\text{NH}_4^+]$</td>
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<td>$K_s$</td>
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<td>$Y$</td>
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<td>$\mu_n$</td>
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<td>$S_i$</td>
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k_{20} - Reaction constant at 20°C (day^{-1})

D - Filter depth (m)

Q_v - Flow rate per unit cross-sectional area (m^3/day per m^2)

T - Liquid contact time

C - Constant for packing used

q - Hydraulic loading

n - Hydraulic constant for the packing material used, unitless

Q - Influent flowrate (L/min)

A - Filter cross section area (m^2)

R - Recirculation ratio

Q_r - Recycling flowrate of effluent (L/hr)

[BOD] - Concentration of Biological Oxygen Demand (BOD₃) in mg/L

[COD] - Concentration of Chemical Oxygen Demand (COD) in mg/L

[NH₃ - N] - Concentration of Ammonia - Nitrogen in mg/L

[NO₃ - N] - Concentration of Nitrate - Nitrogen in mg/L

R_1 - Removal of pollutant (%)

[TSS] - Concentration of Total Suspended Solids (TSS) in mg/L

[P] - Concentration of Phosphorus, P in mg/L

J - Flux of substrate into biofilm (mg/cm²/d)

R_e - Reynolds number

ρ - Density of the wastewater

V - Flow velocity

L - Trickling filter height
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Trickling filter (TF) has been one of the pioneers in wastewater treatment system. Due to its low power consumption and the global concern for sustainable development, the cleaner technology is trending towards more eco–friendly treatment system. In this TF system, it is an attached growth process, meaning, the system employs the microorganisms that grow on media to remove pollutants once the wastewater is in contact with the media which contains populated microorganisms. The media contained in the TF system used in this research is termed as spherical hollow celluloid in hexagonal close – packed (HCP) arrangement. Light – weight and with aplenty voids, the media serve as a durable and low maintenance mean for the microorganisms to propagate. Several types of pollutants were studied during the course of this research but the main emphasis was on nitrogenous compounds and the ability of the TF system to remove these pollutants. Prior to experimental runs, the TF system underwent start – up process, a duration which the microorganisms started to grow on the exterior and interior of the media. Under controlled dissolved oxygen (DO) level and at favorable pH during the commencement of the experimental works, the TF system was able to reject the pollutants satisfactorily, even surpassing the performance that of conventional TF systems.