

Performance of an upflow sand filter as a point-of-use treatment system in rural areas

ABSTRACT

An upflow sand filter operated in incremental filtration rates (0.072, 0.181, 0.481 m³ m⁻² h⁻¹) was studied for turbidity, total suspended solids (TSS), ammonia (NH₄), and total coliform removal rates. Each cycle lasted for 45 days. The filter bed was made of sand with 0.10 mm D₁₀ and supported by 0.49 mm and 2.10 mm gravel with a total bed depth of 0.50 m. Turbidity removal was recorded above 80% in all cycles with a maximum concentration of 7.29 NTU. TSS removal was maintained at over 90%, with an average discharge of 4.77 mg/L in all cycles. The NH₄ removal increased steadily to 91% for 0.072 m³ m⁻² h⁻¹ and 93% for 0.181 m³ m⁻² h⁻¹ filtration rate. The algal bloom occurrence at 0.481 m³ m⁻² h⁻¹ filtration rate overloaded the system with NH₄, declining the removal rate to 45%. Total coliform removal recorded an average of 99% in 0.072 m³ m⁻² h⁻¹, 89% in 0.181 m³ m⁻² h⁻¹, and 66% in 0.481 m³ m⁻² h⁻¹. A high filtration rate resulted in a shorter contact time between pollutants and microorganisms within the filter bed, which reduces the removal efficiency. The Shearing effect was also experienced where the attachments of particles and bacteria were minimised.