Dataset Explanatory Notes

Sheet 1. Sieve analysis

The data was obtained from a sieve analysis test on three aggregate media sample sizes (13 mm, 9 mm and 6 mm) of 1000 g each. It also provides raw data on detailed particle distribution tables for the filter media. A gradation curve was plotted from the particle distribution data presented in the Tables. The logarithm plot was used to compute the uniformity coefficient (C_u) and coefficient of curvature (C_c), which are computed from extrapolating 10, 30 and 60 % of the material that passed through the corresponding sieve.

Sheet 2. Kuils River Raw Water Quality

The data was obtained from Kuils River raw water laboratory analysis. The data indicates the quality of the initial raw water before filtration from twenty tested sample batches. The water parameters examined were pH, turbidity, dissolved oxygen, temperature, chemical oxygen demand (COD), total suspended solids (TSS), nitrate, and nitrate concentrations. The data sheet also provides detailed tables of raw water quality for each parameter before and after filtering using a vertical roughing filter with an external carbon source (VRF_{wt}) and a roughing filter without a carbon source (VRF_{wo}). Moreover, Potassium nitrate was also used to spike the initial raw water nitrate concentration to attain nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N.

Sheet 3. Permeability test

The data was obtained from a permeability test that was performed to estimate the permeability coefficient of each filter media size (13 mm, 9 mm and 6 mm. A laboratory permeameter was used to determine the permeability of each filter media. The permeability test results for each medium size are presented in the Tables.

Sheet 4. Roughing filter daily flow rate

The data was obtained from monitored changes in flow rate through the vertical roughing filters during the filter run. The changes in flow rate were determined by taking the average flow rates over a significant portion of the fluid cycle. The data sheet also represents a plot of the daily decrease in flow rate in the filter with and without a carbon supply throughout the course of the test period.

Sheet 5. Potential of Hydrogen (pH) daily variation at filter depth

The data was obtained from the monitored daily variations in pH of water during the filter run. The sheet provides pH findings from the raw water and filtrate testing in both the filter with and without a carbon source during the sampling period at different filter depths. The filters were run at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 6. Temperature at varied filter depth

The temperature data was acquired from raw water and filtrate tests in the filter with and without a carbon source during the sampling period. The filters were both run at room temperature, hence there was no temperature control. The data shows the temperature results from the roughing filter with and without a carbon source.

Sheet 7. Dissolved oxygen (DO) at varied filter depth

The DO data was acquired from raw water and filtrate tests in the filter with and without a carbon source during the sampling period. The data shows dissolved oxygen fluctuations in the filter with (VRF_{wt}) and without (VRF_{wo}) a carbon supply. It also presents the DO found in the filtrate during and before running the filters with and without a carbon source at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 8. Chemical Oxygen Demand (COD) removal efficiency at varied filter depth

The COD data was acquired from the tested raw water and filtrate in the filter with a carbon source during and before the filter run. The data shows the residual carbon measured in the filtrate when employing a filter with a carbon source at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 9. Total suspended solids (TSS)

The TSS data was acquired from the tested raw water and filtrate in the filter with a carbon source during and before the filter run. The data represents the TSS removal efficiency in the filter with and without a carbon source at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 10. Turbidity removal efficiency at varied filter depth

The turbidity data was acquired by testing the raw water and filtrate in both the filter with and without a source of carbon during sampling. The data represents the turbidity removal efficiency in the filter with and without a carbon source at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 11. Nitrite (NO_2-) removal efficiency at varied filter depth

The nitrite data was acquired by testing the raw water and filtrate in both the filter with and without a source of carbon during sampling. The data represents the nitrite removal efficiency in the filter with and without a carbon source at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively. I t also shows the nitrite concentration in the filtrate during and before running the filters with and without a carbon source.

Sheet 12. Nitrate (NO_3-) removal efficiency at varied filter depth

The nitrate data was acquired by testing the raw water and filtrate in both the filter with and without a source of carbon during sampling. The data represents the nitrate removal efficiency in the filter with and without a carbon source at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively. It also represents the nitrate concentration in the filtrate during and before running the filters with and without a carbon source. Furthermore, the overall performance of nitrate removal in filters with and without a carbon supply is presented.

Sheet 13. Validation of the Results

Validation of results data was obtained from both the filter with and without a source of carbon during laboratory sampling. The validation was limited to pH, turbidity, dissolved oxygen, temperature, COD, nitrate, and nitrate. The filters were run at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 14. Statistical Analysis

The statistical analysis data was obtained from a two-way analysis of variance (ANOVA) that was used to test the null hypothesis that the measured parameters which include pH, dissolved Oxygen (DO), nitrite (NO2-) and temperature have a significant influence on the removal of nitrate (NO_3-) in the vertical roughing filter with or without an external carbon source at varied nitrate concentrations and C/N ratios. The filters were run at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.

Sheet 15. Kinetic reaction rate

The kinetic reaction rate data was obtained from the filter with an external carbon source (VRF_{wt}) and the filter without an external carbon source (VRF_{wo}) that were each evaluated at inflow nitrate concentrations of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N, in order to obtain the best data plot that will best describe the removal of nitrate in a vertical roughing filter.

The model development related the inlet and outlet nitrate concentrations as a function of physiochemical parameters such as flow rate, dissolved oxygen concentration, pH, C/N ratio and temperature. The removal of nitrate in an upward vertical roughing filter process by heterogeneous microorganisms was evaluated based on the reaction rate verses the outflow nitrate concentration as presented in Figures. The approach used was also based on the assumption that the rate of reaction was proportional to the n^{th} power of the nitrate concentration.

Sheet 16. Kinetic reaction rate order (n)

The kinetic reaction rate order data was obtained from the filter with an external carbon source (VRF_{wt}) and the filter without an external carbon source (VRF_{wo}) that were each evaluated at inflow nitrate concentrations of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N, in order to obtain the best data plot that will best describe the removal of nitrate in a vertical roughing filter.

The nitrate removal model development related the inlet and outlet nitrate concentrations as a function of physiochemical parameters such as flow rate, dissolved oxygen concentration, pH, C/N ratio and temperature. The kinetic reaction rate order in an upward vertical roughing filter process was evaluated based on a log-log plot of the experimental data to obtain a reaction rate order (n) as illustrated in the data sheet.

Sheet 17. Kinetic reaction rate constant (k_0)

The kinetic reaction rate order data was obtained from the filter with an external carbon source (VRF_{wt}) and the filter without an external carbon source (VRF_{wo}) that were each evaluated at inflow nitrate concentrations of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N, in order to obtain the best data plot that will best describe the removal of nitrate in a vertical roughing filter.

The nitrate removal model development related the inlet and outlet nitrate concentrations as a function of physiochemical parameters such as flow rate, dissolved oxygen concentration, pH, C/N ratio and temperature. The zero kinetic reaction rate constant (k_0) was estimated by a regression analysis of outflow nitrate concentration (Ce), with respect to time of sampling as presented in datasheet.

Sheet 18. The regression analysis

The kinetic reaction rate order data was obtained from the filter with an external carbon source (VRF_{wt}) and the filter without an external carbon source (VRF_{wo}) that were each evaluated at inflow nitrate concentrations of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N, in order to obtain the best data plot that will best describe the removal of nitrate in a vertical roughing filter. The regression analysis data and zero order kinetic coefficients on all results obtained are listed in the provided data sheet. provides detailed analysis and laboratory results data for the predictive nitrate removal rate model development from the filter with and without a carbon source.

Sheet 19. Daily water parameter concentrations and removal efficiency with filter depth

The data was obtained from the daily laboratory monitoring of the filter with an external carbon source (VRF_{wt}) and the filter without an external carbon source (VRF_{wo}). The water parameters examined were pH, turbidity, dissolved oxygen, temperature, nitrate, and nitrate concentrations. The daily removal efficiency of each parameter at varied filter depth of 270 mm, 750 mm and 1000 mm are presented. Again, the removal efficiency of each filter column containing successive filter media sizes of 13 mm, 9 mm and 6 mm were evaluated. The filters were evaluated at carbon to nitrogen (C/N) ratio of 1.05, 1.08 and 1.1 and inflow nitrate concentration of 15 mg/L-N, 25 mg/L-N and 50 mg/L-N respectively.